A note on the accentuation of Damascene Arabic

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Three models of metrical stress assignment in the Arabic dialect of Damascus (Halle and Vergnaud 1978; McCarthy 1979a, b; Hayes 1979) are considered. On the basis of anomalies in the stressing of third person feminine singular perfective verbs with pronominal suffixes, it is shown that the mora-counting ternary foot model of McCarthy (1979a, b) is superior. In addition, support is provided for cyclic assignment of metrical structure (Kiparsky 1979).

The stress phenomena of the Arabic dialect spoken in Damascus are of some theoretical significance. They apparently reflect a very common process or conjunction of processes, since the basic principle of stress assignment is, with small variations, essentially identical to those of Classical Latin and English. Three metrical theories of stress assignment have been offered as accounts of the Damascene Arabic data, and it will emerge that all are adequate treatments of the central facts. Additional forms with apparently morphologically restricted stress will then be introduced. These motivate two results: first, the cyclic assignment of metrical structure, proposed by Kiparsky (1979); and, second, a choice on purely empirical grounds among the three metrical theories. The discussion will conclude with some further consequences of cyclic assignment of metrical structure.

As a preliminary to the analysis of stress in this dialect, I will first outline a theory of syllable structure and its role in accentuation along the lines presented in Kiparsky (1979) and McCarthy (1979a, b). A syllable is represented as a binary-branching tree with segments as terminal nodes and the node s as root. We can also assume that all nonroot nodes of the tree are in a relation of relative strength indicated by complementary labels s-w, where greater metrical strength is mapped onto greater segmental sonority. This last assumption, though, will play no role in the following pages. Each language selects in a principled way from some universal set of the syllable types generated by this apparatus.

Damascene Arabic recognizes just three basic types of syllables: CV, CVC, and CVV (where V represents a long vowel, a sequence of two vocalic morae). In what follows, I will ignore some additional complications introduced by the possibility of syllable-initial consonant clusters, since they have no role in accentuation and therefore could not affect the analysis presented here. The theory of syllable structure provides a single possible structure, that in (3), for syllables of the CV type:

\[ \frac{V}{C} \frac{V}{s} \]

It offers two possible structures, those in (4a) and (4b), for syllables of
either the CVV or CVC types:

\[ (4) \ a. \quad b. \]

\[ \text{In fact, the grammar of Damascene Arabic adopts the analysis in (4a) on the basis of accentual considerations that will be illuminated shortly.} \]

Therefore the full inventory of basic Damascene syllable structures appears in (5), modulo some additional apparatus to deal with word-initial consonant clusters:

\[ (5) \ a. \quad b. \quad c. \]

\[ \text{To complete the procedure of syllabification, the grammar must also provide a rule of disambiguation (Clements and Keyser 1980), a principle by which conflicting assignments of segments to syllables can be resolved. The sole case of this sort for the structures in (5) is, of course, a single inter-vocalic consonant. In fact, in a sequence \ldots VCV\ldots the consonant is, perhaps universally, assigned to the following syllable rather than the preceding one.} \]

Two additional syllable types, CVVC and CVCC, appear in Damascene Arabic, though these have a highly restricted distribution, occurring only at the end of a word in underlying representation. In McCarthy (1979a, b) it is argued that these syllables have the complex structure in (6), derived by a rule which Chomsky-adjoins an unassociated word-final consonant to a preceding syllable:

\[ (6) \ a. \quad b. \]

\[ \text{Alternative formal treatments of these syllable types have been suggested in later work (Aoun 1979, Hayes 1980), some of it based on other languages, but for the particular accentual questions addressed here these other proposals are roughly equivalent to (6).} \]

This model of syllabification provides a straightforward characterization of the notion of syllable weight, which plays a role in the Damascene system of stress assignment. A light syllable has the structure (5a) and a heavy syllable is one of (5b) or (5c). A third degree of weight -- superheavy-- is represented as (6a) or (6b). Syllable weight can be interpreted geometrically in these trees by first recognizing a subconstituent of each syllable, the rhyme, defined as the right branch of any node \( \sigma \). Given this definition, it is apparent that a light syllable has a nonbranching (simplex) rhyme, a heavy syllable has a branching (complex) rhyme, and a superheavy syllable has two rhymes, of which the first is branching and the second nonbranching. I will assume in what follows that the representation to which stress is applied in Damascene Arabic is restricted solely to information about the branching character of syllable rhymes. An explicit procedure to ensure this can be found in Halle and Vergnaud (1978) and McCarthy (1979a, b).

Having dispensed with these syllabic preliminaries, we can proceed to the analysis of the Damascene stress pattern. The forms in (7) exemplify the basic rule of accentuation:

\[ (7) \ a. \text{ madāra } '\text{schools}' \quad \text{katadh } '\text{you (f. sg.) wrote}' \]

\[ b. \text{ kātab } '\text{he wrote}' \quad \text{kadāb } '\text{he wrote to}' \]

\[ c. \text{ dārasu } '\text{they studied}' \quad \text{madāras } '\text{school}' \]

\[ d. \text{ darāst } '\text{I/you (m. sg.) studied}' \quad \text{zaarūk } '\text{they visited you (m. sg.)}' \]

The forms in (7a, b, c) show the stress distribution typical of the English or Latin stress rules. Stress falls on the penultimate syllable when it is heavy (7a) and in disyllables (7b). Otherwise stress falls on the antepenult (7c). Forms like mutā şikayīdī 'united (f. sg.)' borrowed from Literary Arabic show that stress does not retract to the preantepenult even when the penult and the antepenult are light. Finally, the examples in (7d) display the characteristic stressing of a superheavy ultima.

It is apparent that the typology of syllables based on rhyme geometry introduced above will at least suffice to make the distinctions implied by (7). The problem now is to provide a mechanism to apply stress by referring directly to this rhyme geometry. In Prince (1976), Halle and Vergnaud (1978), McCarthy (1979a, b), Hayes (1979, 1980), and other works, a revision of the metrical theory of stress (Lieberman and Prince 1977) is proposed in which metrical feet whose terminal nodes are typically syllable rhymes are assigned to words. Various possible conditions on the structure of metrical feet and of their terminal nodes constitute the parameters of interlinguistic variation in stress assignment. The familiar devices of metrical labeling select the most prominent syllable in each foot. Furthermore, word-level metrical structure and its concomitant labeling rule designate the most prominent foot within each word, the foot whose most prominent syllable bears the main stress.

The basic problem in the formal characterization of Damascene stress or its parallels in English and Latin is the description of the structure of the foot, since, as we shall see, other apparatus serves only to label the last foot in any word as most prominent. The object at this point is to consider several possibilities for the Damascene foot with an eye toward
determining some of the universal parameters of foot structure.

Halle and Vergnaud (1978) offer an analysis of Damascene stress in which, informally, the foot includes all syllable rhymes from the stress to the right end of the word. This yields the foot structures in (8) for some representative examples from (7) (feats are indicated by the node $\dagger$):

(8) a.  
\[ \text{ka tab ti} \]

b.  
\[ \text{ka tab} \]

c.  
\[ \text{da ra su} \]

d.  
\[ \text{mad ra se} \]

e.  
\[ \text{da ra t} \]

Subsequently a right-branching word-level tree is created whose terminal nodes are feet and previously unassociated syllables. Both foot and word-level metrical structure are labeled according to the principle that, in any pair of sister nodes, the right node is strong if and only if it branches. The final metrical structures for the forms in (8) are given in (9):

(9) a.  
\[ \text{ka tab ti} \]

b.  
\[ \text{ka tab} \]

c.  
\[ \text{da ra su} \]

d.  
\[ \text{mad ra se} \]

e.  
\[ \text{da ra t} \]

The stress correctly falls on the syllable whose rhyme is the designated terminal element, that node which is dominated only by the label $s$ or the root. Notice in particular that the final superheavy syllable of (9a), which has two rhymes, receives a metrical structure formally identical to that of a word with a heavy penult like (9a).$^1$

To generate the foot structures in (8), Halle and Vergnaud (1978) provide three conditions:$^6$

(10) For any foot $\dagger$:

a. $\dagger$ is left-branching.

b. $\dagger$ is assigned at the right end of the word.

c. $\dagger$ dominates no more than three syllables.

It is presumed as well, in this and the other analyses discussed below, that a foot must universally be mapped onto as much of a word as possible consistent with the principles of foot construction. In other words, the theory provides that all feet be maximal.

Condition (10a) stipulates not only the overall structure of the foot but also the positions that heavy syllables, with their branching rhymes, can occupy in it. A left-branching foot like that of Damascene Arabic will permit branching rhymes, and therefore heavy syllables, in only the leftmost terminal position of the foot. Thus, foot assignments like those in (11) will be ill-formed:

(11) a.  
\[ \text{ka tab ti} \]

b.  
\[ \text{ka tab} \]

c.  
\[ \text{ka tab} \]

In fact, this consequence is undesirable in cases like (11b) and (11c), since we do wish to assign such feet to words with heavy ultimas (compare (8b)). As this problem of the lack of influence of heavy ultimas on foot formation will be discussed below, I will not now maintain the fiction that all ultimas have nonbranching rhymes, for cases (11b) and (11c) will not arise.

The other two conditions on foot assignment are virtually self-explanatory. The direction of foot assignment (10b) essentially mimics the reference to word-boundary in a conventional segmental formulation of a rule of this sort. The upper bound on number of syllables (10c) ensures that forms like muttabide will receive antepenultimate stress, rather than the initial stress expected if no such condition existed.

An alternative characterization of the Damascene Arabic foot structures is given in McCarthy (1979a, b). Informally, a foot can be described as a sequence containing the first mora of the stressed syllable plus, at most, two following morae. This yields a rather different foot analysis or metrical parse from that in (8):

(12) a.  
\[ \text{ka tab ti} \]

b.  
\[ \text{ka tab} \]

c.  
\[ \text{da ra su} \]

d.  
\[ \text{mad ra se} \]

e.  
\[ \text{da ra t} \]

The metrical analyses in (12) differ from those in (8) in the foot structure assigned to words like mâdrâse with a heavy antepenult and a light penult. Halle and Vergnaud's (1978) rule (10) treats this entire form as a single foot, while in (12) the final syllable is excluded from the foot. On the other hand, in both cases identical foot structures are provided for forms like dâra'us with light penults and antepenults. Both models assign identical word-level trees and metrical labeling, and both yield identical stress patterns at the end of the derivation for all forms in (7).

The theory which generates the feet in (12) has the following form.

A foot may be stipulated as either right- or left-branching and as assigned from either the right or the left. The basic difference between this and the proposal of Halle and Vergnaud (1978) is that, in this one, feet are bounded in size by the number of terminal nodes they have rather than the number of syllables they dominate. Since a nonbranching terminal node of a foot is either the rhyme of a light syllable or one daughter of the rhyme of a heavy syllable, a terminal node is similar to the traditional notion of a mora, the unit of syllable weight.
Under this theory, the rule of foot formation in Damascene Arabic is:

(13) For any foot $\phi$:

a. $\phi$ is maximally of the form

\[
\begin{array}{c}
\text{n}_1 \\
\text{n}_2 \\
\text{n}_3
\end{array}
\]

b. $\phi$ is assigned at the right end of the word.

The theory provides that $n_1$ and $n_3$ are terminal nodes (i.e., nonbranching) and that only three foot types (binary, ternary like (13a), and unbounded) are universally possible. The properties of $n_2$ are contingent on the treatment given to final heavy syllables, a problem which will be dealt with shortly.

In sum, we have two distinct theories of metrical structure applied to the basic phenomena of Damascene Arabic. That of Halle and Vergnaud (1978) is founded on a conception of the foot as bounded by the number of syllables it contains, and that of McCarthy (1979a, b) characterizes feet by a maximal number of moras. Although this theoretical difference yields different foot parses for words like middage, it has no consequences for the observed stress in (7), since both proposals handle these facts successfully. It would appear that Damascene Arabic underdetermines the choice between these two quite distinct theories of foot structure.

This impasse is made even more serious by the existence of still another proposal for Damascene stress which initially yields different foot structures from both other theories. In Liberman and Prince (1977) and Nanni (1977) it is argued that certain final syllables in English are extrametrical and therefore transparent to the basic processes assigning stress and metrical structure. Hayes (1979, 1980) extends this notion to cases like Damascene Arabic and Latin in an interesting proposal that would eliminate the need for assignment of ternary feet like those used in the other analyses. It is stipulated in the grammar of Damascene Arabic that the final rhyme of any word is extrametrical, so this rhyme is ignored in the formation of feet. If we indicate syllables with extrametrical rhymes by parentheses, then the forms of (8) and (12) should have the following foot structures:

(14) a. $\phi$

\begin{array}{c}
\text{k}a \text{ tas} \text{ (ti)} \\
\text{k}l \text{ (tsb)} \\
\text{da} \text{ ra} \text{ (su)}
\end{array}

d. $\phi$

\begin{array}{c}
\text{mad} \text{ ra} \text{ (se)} \\
\text{da} \text{ ras} \text{ (t)}
\end{array}

Note that in the cases where the penultimate rhyme is heavy (14a, c), the foot and the rhyme are exactly coextensive. In addition, note that the foot dominates at most two syllables (14c, d). Subsequent erection of word-level structure and labeling yield the correct stress.

Since the extrametrical syllable presumably does bear some relationship of relative prominence to the rest of the word, it is assumed by Hayes (1979) that any extrametrical syllable is later adjoined as a weak sister to the adjacent foot, yielding derived ternary feet in many cases. Further details of the formulation of this adjunction rule may be found in Hayes (1980).

The rule of foot formation in this metrical model will have the following conditions:

(15) a. Mark word-final rhymes as extrametrical.

For any foot $\phi$:

b. $\phi$ is left-branching.

c. $\phi$ is assigned at the right end of the word.

d. $\phi$ dominates no more than two syllables.

There are several virtues of this analysis claimed by Hayes (1979), of which two are directly applicable to the Damascene Arabic problem. First, with extrametricality it is possible to eliminate ternary feet from the universal inventory of foot types, an obvious simplification in the theory. Second, extrametricality offers a resolution of the problem of syllable weight contrasts word-finally.

We have already seen cases of superheavy syllables attracting stress in word-final position. Formally this has been attributed to the double rhyme associated with this syllable type. What has not yet been made explicit is the absence of an accentual contrast between light and heavy syllables word-finally. Surface light syllables (CV) and heavy syllables (CVC) are both unstressed at the end of a word. This means that the heaviness -- or branching rhyme -- of a final CVC syllable is somehow overlooked by the apparatus of foot-formation and labeling in Damascene Arabic. This difficulty is solved almost automatically under the solution that marks final syllables as extrametrical; the final syllable's weight cannot affect the placement of stress. The only stipulation demanded by these facts is that the extrametrical syllable must be adjoined as a weak sister, since reaplication of the usual labeling rule would render a heavy extrametrical syllable stressed. This stipulation is apparently part of the theory.

There are other accounts of this phenomenon, however. Halle and Vergnaud (1978) suggest that the final rhyme is conventionally simplified without affecting its segmental make-up. Thus, final CVC syllables are light for the purpose of stress assignment only. Prince (1980), dealing with a similar problem in Estonian, asserts that word-final syllables may have the left-branching internal structure of (4b), providing them alone with nonbranching rhymes. So final CVC syllables are light for all rules that might refer to syllable structure. The proposal of McCarthy (1979a) is that the node $n_3$ of (13a) may branch or not branch freely, so it can dominate a heavy syllable or a light one. Furthermore, the branching structure at the level of the rhyme is opaque, meaning that it may not affect metrical labeling. Both of these parameters -- the treatment of $n_3$ and opaque domains -- are claimed to be subject to interlinguistic variation. In any case, what all these proposals have in common is that they allow heavy syllables to be treated formally as light in word-final position. In this they are distinct from the theory of Hayes (1979) that marks all
final syllables of both weights as extrametrical. This completes the summary of the different approaches to Damascene stress.

Although all three analyses presented here are equally capable of generating the stress of the forms in (7), some additional data permit us to distinguish between them. In a number of Arabic dialects certain irregularities in stress assignment center around the accentuation of third person feminine singular perfective verbs followed by vowel-initial pronominal object suffixes. These have previously been studied in a number of works (Dimov 1970, Broselow 1976, Welden 1977, McCarthy 1979b), but none of these studies has focused on the synchronous problem in Damascene Arabic.

The facts appear in (17):  

(17)  

<table>
<thead>
<tr>
<th>Without Suffix</th>
<th>With Suffix (3rd m. sg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. fātēt 'she opened'</td>
<td>fātēto 'she opened it'</td>
</tr>
<tr>
<td>ūsāfet 'she saw'</td>
<td>ūsāfeto 'she saw him'</td>
</tr>
<tr>
<td>tāmālet 'she bore'</td>
<td>tāmālto 'she bore him'</td>
</tr>
<tr>
<td>b. gāllāmat 'she taught'</td>
<td>gāllāmotto 'she taught him'</td>
</tr>
<tr>
<td>kātabēt 'she wrote to'</td>
<td>kātabeto 'she wrote to him'</td>
</tr>
<tr>
<td>ākrāmēt 'she honored'</td>
<td>ākrāmotto 'she honored him'</td>
</tr>
</tbody>
</table>

Similar stress patterns are found with the pronominal object suffixes *āk* 'you (m. sg.)' and *ēk* 'you (f. sg.).' To understand fully what is going on here in (17), we must consider some of the segmental phonology that is at work. First, the forms fātēt and tāmālet are analyzable as /fatayet/ and /tamatel/et/, since the stems /fata/ and /tama/ show up overtly in the rest of the verb paradigm: fātē 'he opened'; fātēha 'they opened'; tāmāl 'he bore'; tāmālu 'they bore'. This deletion of *a* occurs exclusively in the position before the feminine suffix *et* and it must, moreover, be prevented from applying in the verb types of (17b).

Second, short unstressed nonlow vowels are deleted in open nonfinal syllables: *mušēlem* 'teacher', *mušālim* 'teachers'; *šelūg* 'he came out', *šalūsg* 'they came out'. This rule is responsible for the loss of the vowel *a* in the forms on the right in (17a). Later we will have occasion to sharpen the statement of this process.

Third, the nonlow short vowels reduce to schwa in nonfinal rhymes: *šalūg* 'he did', *šalūl* '1/you (m. sg.) did'. This reduction is responsible for the quality of the stressed vowel in the forms on the right in (17b).

Since the correct formal statement of the first two rules depends on details of the metrical structure that are at issue here, I will delay formulating them until this structure has been clarified. Nevertheless, we can use the informal statements above to extract the underlying representations of the forms in (17). These are presented in (18):

The suffixed forms in (18b) are doubly anomalous. They fail to undergo a-deletion, which applies in (18a), and they have penultimate stress assigned to them contrary to the stress rule in any formulation. There is a phonological characterization of the (18a)/(18b) distinction: in (18b) *et* is preceded by a heavy syllable-light syllable sequence, whereas it is preceded by some other sequence (light-light or heavy) in (18a). This is a fairly barefoot phonological condition. It could be incorporated into the formulation of both a-deletion and stress assignment only with a substantial loss of generality.

The fact that the penultimate stress of (17b) is limited to a conjunction of certain nonphonological properties — a third feminine singular perfective verb with pronominal suffix — suggests that we should look for an account of this phenomenon that makes some use of morphological structure. An explanatory treatment of all these anomalies can be found within a theory that assigns metrical structure cyclically, following a proposal made by Riperasky (1979). Here I will assume slightly different principles of cyclic rule application from Riperasky. I make the natural assumption that syllabification is a cyclic process, so syllables will be restructured as necessary at the start of each new cycle (Borer 1979, McCarthy 1979a). Stress is applied by assigning foot structure only on each cycle, subject to the apparently universal condition that newly assigned foot structure does not overlap with or supplant structure inherited from previous cycles (Hayes 1980). On the superordinate, or word-level, cycle, word-level structure and labeling are assigned, yielding the observed stress.

For an inflected verb form like ūsāfet with a pronominal suffix like *āk*, the natural cyclic bracketing is **(ūsāfeto)**. Similar constituency of Arabic verbs is assumed by Brame (1973). Cyclic application of the moraic stress rule (13) of McCarthy (1979a, b) yields the derivation in (19):
Foot assignment on the subordinate cycle (19a) creates a foot coextensive with the form ɓaat. On the superordinate cycle, the structure inherited from the first cycle is retained, so only the single syllable te is unassociated. Strictly speaking, the foot schema (13) could be applied to a single syllable, light or heavy, to yield a degenerate foot. There is, however, independent motivation, discussed below, for a stipulation in the grammar of Damascene to prohibit this sort of foot assignment. Therefore no foot is assigned on this cycle, so te is incorporated into the tree by word-level structure. Labeling correctly provides initial stress.

The derivation of a form like yallamūtu is rather different:

(20) a. First Cycle
Syllabification
9al la met
Foot Assignment
9al la met

b. Second Cycle
Syllabification
9al la me to
Foot Assignment
9al la me to
Word-level Structure
and Labeling
9al la me to

Application of foot assignment on the subordinate cycle leaves the final syllable met unassociated. Foot assignment applies again on the superordinate cycle, creating a binary foot over the sequence met. A larger foot would be impossible without overlapping preexisting structure. The word-level tree and labeling correctly select the penult as the main-stressed syllable. This tree is also consistent with a secondary stress on the initial syllable, though convincing observations of secondary stress are lacking.

The anomalous penult stress of yallamūtu, then, is a consequence of carrying over metrical structure between cyclic rule applications. The difference between /ɓaat/ and /yallamūtu/, which was informally attributed to the presence of a heavy preantepenult in the latter, can now be traced to the sequence assigned to a foot on the subordinate cycle. In /ɓaat/, the footed string is the entire constituent ɓaat, but in /yallamūtu/ it is only the first two syllables 9al with the single syllable met not yet contained in any foot. This difference controls the possibility of reapplying foot assignment on the superordinate cycle.

Further support for this proposal comes from the formal statement of the rule of a-deletion. Recall that the problem is the failure of a-deletion to apply in the forms in (17b) like ɓalmet or yallamūtu.

This problem can be solved, however, if we observe that forms with and without a-deletion have different metrical foot structures. Compare the stress derivation for ɓaibeto in (21) with that of yallamūtu in (20):

(21) a. First Cycle
Syllabification
fa ta het
Foot Assignment
fa ta het

b. Second Cycle
Syllabification
fa ta he to
Foot Assignment
Word-level Structure
and Labeling
da
fa ta he to

The stress assignment in (21) is unremarkable, since it exactly parallels the derivation of ɓaat/ in (19). Notice, however, that the deletable a of /ɓaat/ is the medial branch of a foot while in /yallamūtu/ the undeletable a is the final branch. If we allow direct reference to prosodic categories like the foot in phonological rules (Selkirk 1980, Prince 1980, McCarthy 1979a), then a formulation of a-deletion is possible which encodes this observation:

(22) a-deletion

\[ a + \phi / [X \_ Y] \_ \phi /3rd fem. sg. perfv. \]

Conditions: \( \phi = \text{foot} \)
\( X, Y \neq \phi \)

Rule (22) says that a deletes under a particular morphological condition when it is internal to a foot, so it is retained when foot-final. Additional apparatus will be needed to suppress (22) in forms like ɓaat/, presumably by requiring that X and the focus be heterosyllabic.

Both these results -- the stressing of suffixed forms and the formulation of a-deletion -- depend crucially on the assignment of different metrical parses to /ɓaat/ versus /yallamūtu/ or /ɓaat/. Different parses are in fact assigned by the moraic foot model of McCarthy (1979a, b), as we have seen in the derivations above. Neither of the other models of foot assignment is able to capture this distinction without modifications that sacrifice fundamental characteristics.

The syllabic foot theory of Halle and Vergnaud (1978) assigns the entire strings /ɓaat/, /ɓaat/, and /yallamūtu/ to feet. This can be seen by comparison with parallel forms in (8). The foot assignment rule in this model is insensitive to the difference in mora count of /yallamūtu/ as against /ɓaat/ or /ɓaat/ since its stipulations limit only the number of syllables dominated by the foot. No ready improvement of this theory which could handle these facts presents itself.
The theory of extrametricality of Hayes (1979) is rather more complex to realize in this regard, though ultimately it too fails to deal with these phenomena. There is a certain ambiguity in the application of the rule "mark the word-final rhyme as extrametrical" to cyclic stress assignment. If taken literally, then the rule will hold only on the superordinate or word-level cycle. The intent of Hayes (1980) is broader; the extrametricality rule will apply on the domain of stress assignment, whatever it is. Thus, we would successively mark the final syllables as extrametrical on each new cycle.

The first alternative can be dismissed quickly. On the subordinate cycle, the foot assigned will be exactly coextensive with any heavy final syllable, as in (23):

\[
\text{(23) a. } \text{[Sal la met]} \text{o} \quad \text{b. } \text{[fta tə met]} \text{o} \quad \text{c. } \text{[ŋaa fət]} \text{o}
\]

Since all three forms have received identical foot structures, this line cannot be pursued successfully.

The second alternative yields similar results. Extrametricality and foot assignment on the subordinate cycle yield the representations in (24):

\[
\text{(24) a. } \text{[Sal la (met)] o} \quad \text{b. } \text{[fta (met)] o} \quad \text{c. } \text{[ŋaa (fet)] o}
\]

Adjunction of extrametrical syllables to adjacent feet conventionally applied immediately after the feet are created (Hayes 1980). This gives structures identical to those of the syllabic foot theory, which was also incapable of making the distinctions necessary to these phenomena. The only possible way to provide the desired feet would be to condition the universal adjunction rule to apply in (24b) and (24c) but not in (24a). This would, of course, alter the theory of extrametricality so as to exactly simulate the molar foot theory while decomposing foot assignment into two operations.

The conclusion, then, on the basis of the cyclic phenomena and the formulation of \(\text{a-deletion}\) in that the molar theory of foot structure (McCarty 1979a, b) is superior to the syllabic theory (Ralle and Vergnaud 1978) and to a theory incorporating extrametricality (Hayes 1979, 1980). This should not be taken as a rejection of this latter theory in particular, since it is supported by a significant body of evidence entirely unrelated to Damascene Arabic. Rather, the argument here demonstrates only that the program of eliminating the problems of assigning ternary feet and of the weight of final syllables by the device of extrametricality is unsuccessful. Instead the theory must permit the assignment of ternary feet to moras along one of the means of dealing with heavy ultims described earlier.\(^8\)

There are some apparent counterexamples to the cyclic analysis of Damascene stress proposed here. These center around two classes of forms: feminine nouns with pronominal suffixes and verbs with consonant-initial suffixes. The former will be dealt with by a morphological process that is entirely distinct from metrical structure assignment, and the latter will motivate an additional rule of foot formation.

Some feminine nouns with vowel-initial pronominal suffixes are almost exactly parallel to the verb forms in (17):

\[
\text{(25) Construct} \\
\text{a. } \text{gūret 'picture'} \\
\text{dārāzet 'degree'} \\
\text{b. } \text{máḥramet 'handkerchief'}
\]

The construct is a grammatical category that usually marks a noun as possessed by the following noun or pronominal suffix. Only feminine nouns have a special construct form, indicated by the suffix \(+t\) or \(+t\).

It is apparent that the forms on the right in (25b), if they have underlying forms like \([\text{máḥramet}]\), are identical in all relevant respects to verbs like \(\text{gūlāmātī}\), yet they do not have penultimate stress. Instead, they are stressed regularly on the underlying antepenult, with subsequent syncope of the unstressed nonlow vowel \(e\). In sum, the suffixed nouns show no evidence of cyclic assignment of metrical structure.

There is an obvious, although ad hoc, solution to this. We might propose a readjustment rule to flatten out the internal constituency of suffixed nouns, so that they would contain no subordinate cyclic domains. A deeper explanation emerges, however, on consideration of some additional data from feminine noun constructs.

There is a significant amount of unexplained variation between \(+t\) and \(+t\) in the form of the feminine construct desinence, as observed by Cowell (1964):

\[
\text{(26) a. Unsuffixed Construct} \\
\text{m′āddām : 'introduction'} \\
\text{madrāst : 'school'} \\
\text{dōox : 'nausea'}
\]

\[
\text{b. Suffixed Construct} \\
\text{baaxārtun } 'our ship' \\
\text{çaaxāyfkon } 'your (pl.) sect' \\
\text{baaxāyfkon } 'our maid'
\]

If the construct invariably had \(+t\), then we would always expect, for example, \(m′āddāmat\) in (26a) and \(baaxārtun\) in (26b).

The rule of syncope of unstressed nonlow vowels in open syllables cannot account for this \(+t\)-\(+t\) alternation for several reasons. First, \(g\) does not
occur in an open syllable at any point in the derivation in a construct phrase like mäddā't 1ākšaḥ /məddəmət/ 'the introduction of the book' or a suffixed construct like baaxətəna /baaxəretna/. Second, even when a vowel does follow in the surface form of a construct phrase, as in wágift əl̥īfțra 'the physics assignment', this vowel əl̥īf is a product of the epenthesis rule mentioned in note 6. The epenthetic vowels do not normally feed the syncope process, a circumstance that can be accounted for by ordering syncope before epenthesis. Third, the ët construct form affects the placement of stress — we would expect stress on the underlying antepenult in /məddā'təm/ and penult in /baaxəretəm/, rather than the observed stress in (26). Finally, the appearance of a construct in ët is truly variable and apparently limited to forms of relatively high frequency, neither of which are characteristic of the syncope process.

Since the ët-ët alternation in feminine constructs cannot be attributed to familiar phonological causes, we must reckon instead with a process of allomorphy (Aronoff 1976). When the suffix ët marks the feminine construct, it optionally changes to ët, without phonological conditions.6 Like many variable rules, this one applies more readily in constructs or construct phrases of greater frequency. Following Aronoff, I will assume that this allomorphy rule applies directly to underlying representations, before the application of any phonological rules. This accounts for the fact that this alternation can condition the placement of stress and bleed nonlow vowel syncope in forms like /baaxəretənə/.

Now that we have motivated this allomorphy rule, we can apply it to the problem raised by the forms in (25b). Recall that there the cyclic application of metrical structure should yield stress on the ã of the feminine construct desinence ãn some noun types, as in mañərəntə. If, however, this ã has already been deleted by the allomorphy rule before stress applies, then the problem clearly does not arise. Instead, the representation [[mañərəntə]] will regularly receive stress on its super-heavy ultima on the subordinate cycle, and this stress will be maintained on the superordinate cycle.7 Therefore, in these nouns cyclic rule application will have no observable phonological consequences.

This analysis, although it accounts for the data elegantly, does have one possibly objectionable characteristic. There is no variation in the suffixed construct forms of (25b), so we must say that they obligatorily select the ët allomorph of the feminine construct. I will claim, then, that the allomorphy rule is conditionally variable: it is truly variable in unsuffixed constructs and before consonant-initial pronoun suffixes, but it is obligatory before vowel-initial pronoun suffixes. This phonological distinction in pronoun suffix types appears to recapitulate the open-syllable environment of nonlow vowel syncope, and for that reason involves some loss of generality in the system as a whole. Nevertheless, it is not difficult to understand from a diachronic perspective. Alternations in the feminine construct that were originally governed purely by syncope are being morphologized by leveling in the direction of an invariant ët construct desinence. This leveling has been completed in the forms with vowel-initial suffixes, though it remains variable elsewhere. At this point in the development both the allomorphy rule and the syncope rule have synchronic motivation.

Issues more directly relevant to the theory of metrical structure are raised by verb forms with pronominal suffixes which have surface heavy penults. These show penultimate stress without exception:

(27) Without Suffix With Suffix
a. yəsmäŋ 'that he hear' yəsməŋkən 'that he hear you' (pl.)
  ṣəfet 'she saw' ṣəfətən 'she saw you (pl.)'
  ṣəfə 'we saw' ṣəfətən 'we saw them'
b. kädəbet 'she wrote to' kädəbetkən 'she wrote to you (pl.)'
  9əlləmət 'she taught' 9əlləmətkən 'she taught you (pl.)'

The problem in (27) is that the forms on the right, although they have the requisite internal constituency, do not show the effect of cyclic assignment of metrical structure. We would expect all of them to have initial stress, exactly like the unsuffixed forms on the left in (27). This prediction can be seen from the cyclic derivation of yəsməŋkən:

(28) [[yəsməŋ]kən]

a. First Cycle
   Syllabification yes mə9
   Foot Assignment DNA
   b. Second Cycle
      Syllabification yes mə9kən
      Foot Assignment DNA
      Word-Level Structure and Labeling
         DNA

This structure, derived by cyclic foot formation alone, is clearly incorrect. Some additional stipulation will be needed to account for stress in forms of this type.

There are various solutions possible at this juncture; I will present one of them and then show some independent motivation for it. Suppose that the grammar of Damascene recognizes a rule that manipulates foot structures other than the basic foot assignment rule. This new rule will apply on the superordinate cycle to a form like yəsməŋkən/ to yield the derived foot structure in (29):

(29) yes mə9kən

This representation, in which a single foot has been restructured as two
separate feet, is then subject to the usual assignment of word-level structure and labeling, correctly yielding penultimate stress.

This rule of foot restructuring is formulated in (30):

(30) Foot Cloning

\[ [n_1 n_2]_\phi n_3 + [n_1]_\phi [n_2 n_3]_\phi \text{ Condition: } n_2 \text{ branches.} \]

This says that a foot \( \phi \), if its right daughter \( (n_r) \) is a heavy syllable and it is followed by a syllable rhyme \( (n_l) \), will be restructured into two feet. The second foot is composed of the heavy syllable from the old foot plus the following rhyme node. The residue of the old foot forms the first foot. I will assume that this rule is ordered after foot assignment and crucially before the assignment of word-level structure and labeling.

Rule (30) will correctly apply to the foot structure in (28b) to yield that in (29), and it will work similarly with all the problematic examples in (27) of verbs with pronominal suffixes and surface heavy penults. In these cases it functions solely to correct the foot structure inherited from prior cyclic stress application. There is, however, other evidence in support of (30) that shows the effects of cyclic rules directly.

It has been observed in nonmetrical phonological studies of other Arabic dialects by Brame (1970, 1973) that suffixed verb forms similar to those in (27) do in fact give overt testimony of cyclic rule application under some conditions. Parallel data can be found in Damascene Arabic. Compare the suffixed and unsuffixed verb forms in (31):

(31) Without Suffix

nəsi 'he forgot'

nəsihi 'he forgot her'

nəsfi 'he forgot you (m. sg.)'

nəsfihi 'id. (f. sg.)'

nəsihi 'he forgot them'

səməq 'he heard'

səməqkon 'he heard you (pl.)'

gədu 'stay (pl.)'

gəduqkon 'stay, you (pl.)'

təsəq 'that it hold'

təsəqkon 'that it hold them'

With Suffix

This sort of notation is to be interpreted as follows (compare Rotenberg 1978). We require that the nonlow vowel be labeled weak, ensuring that it is unstressed.

The interesting characteristic of the forms on the right in (31) is the failure of \( \phi \) to delete despite the fact that it is unstressed in an open syllable. This cannot be attributed to lexical exceptionalness or to the initial syllable position, since syncope applies to this same vowel in related forms like nəli: 'you (m. sg.) forgot', nəfi: 'we forgot', səməq: 'you (m. sg.) heard', or səsi: 'we heard'.

These apparent exceptions to the syncope process in (31) can be attributed to cyclic rule application. Observe that the unstressed nonlow vowel is preserved just in case it is stressed in the corresponding unsuffixed form. Therefore, a vowel that was stressed on the subordinate cycle in effect simulates a stressed vowel for the purpose of applying the syncope rule, even though it is clearly unstressed on the surface.

A formal metrical account of these observations follows readily from the formulation of Foot Cloning in (30). Notice that this rule applies in the forms on the right in (31) to yield the observed penultimate stress. Consider an example like nəsihiha. Foot assignment on the subordinate cycle gives the representation in (32a). On the superordinate cycle foot assignment cannot reapply, but rule (30) will apply to produce the structure in (32b):

(32) a. nəsihiha

b. nəsihiha

The foot containing the rhyme of the initial syllable in (32b) is the residue of the foot in (32a) after restructuring by Foot Cloning.

We can take advantage of this trace of the previous cycle's foot structure in the formulation of the syncope process. The vowel of the open initial syllable in (32b), although it is nonlow and unstressed, nevertheless fails to delete. The basic insight is that nonlow vowel syncope is suppressed either when the vowel is strong within its foot -- that is, when it is stressed -- or when it exhausts its foot, as in (32b). This is formalized in (33):

(33) Syncope

\[ V + \phi / [\_\_\_]_\phi \text{ Conditions: } a = \phi \text{ rhyme} \]

This analysis, which now provides for the cyclic assignment of metrical structure and for a means of passing cyclic information along to the syncope rule, has a few other interesting points as well. First, recall from the discussion of the derivation in (19) that it was necessary to prevent foot assignment from creating a foot that contains only a single rhyme. This stipulation, which is apparently a language-particular one, is needed independently to account for some cases of syncope. In forms without the properties of (31), syncope may apply to the vowel of the initial syllable: səsihiha 'I heard', səməqkon 'you (f. sg.) heard'. The difficulty is that it is usually assumed that foot assignment applies iteratively across a word in the indicated direction. If this is so, then we would expect a foot to be assigned which exhaustively
dominates the initial syllable of a form like /some9t/. This foot, although it would never bear stress, would, however, block syncope of the nonlow vowel in this syllable. This clearly undesirable consequence of iteration can be avoided by preventing the rule of foot assignment from applying to just a single rhyme. This coincides with the need for the same principle in cyclic metrical derivations.

Some independent support for the formulation of the syncope rule comes from a class of truly exceptional stress patterns that are morphologically-controlled. In the verbal derivational classes known as the seventh and eighth conjugations, stress falls on the penult in cases where it could retract to the antepenult:

(34) a. Seventh Conjugation
byənkəsr ‘it will break’
byənkəsteb ‘it will be written’
əmənətəb ‘withdrawing’

b. Eighth Conjugation
byəntəker ‘he will think’
byəntəkəf ‘he will admit’
meəntəgel ‘working’

Stress falls regularly on the underlying antepenult in inflected forms like byənkəsr ‘they will be broken’.

These facts can be seen as supporting the new role of foot assignment that is restricted to the two morphological classes in (34):

(35) Seventh, Eighth Conjugation Stress

Form a foot \([a, n]\) on the root syllables of the seventh and eighth conjugations.

By “root syllables” are intended those syllables bounded by the triconsonantal root. Alternative formulations of these morphological conditions are possible. Rule (35) must precede the regular foot assignment rule, since (35) is more specific of two inherently disjunctive foot assignment rules. The application of (35) is illustrated in (36):

(36) a. byən ke set
b. byən ke se ru

Subsequent assignment of word-level metrical structure and labeling will yield the correct stress for both forms.

It is sometimes suggested in informal descriptions of the facts in (34) that the special rule of stress assignment does not apply in forms with pronominal suffixes. The incorrectness of this position is shown by the failure of syncope in the suffixed forms in (37), where (35) has demonstrably applied on the first cycle:

(37) Without Suffix  With Suffix
byəntəgel ‘he will work’
byəntəgəlɪ ‘he will work for
byəntəgəlɪ ‘he will work for
byəntəgəlɪ ‘he will work for
byəntəgəlɪ ‘he will wait for’
byəntəgərɪ ‘he will wait for’
byəntəgərɪ ‘he will wait for’
byəntəgərɪ ‘he will wait for’
byəntəgərɪ ‘he will wait for’

The syncope facts in (37) are exactly parallel to those in (31). The vowel which is stressed exceptionally by (35) in the unsuffixed form is not subject to syncope in the suffixed form even though it is unstressed. The derivation of these forms will be almost identical to the one in (32): a foot is assigned on the subordinate cycle, and then this foot is restructured by the cloning rule on the superordinate cycle. The difference here is that the foot is assigned on the subordinate cycle by the morphologically-restricted rule (35), rather than the regular stress rule. The fact that all other characteristics of the cyclic analysis hold true despite the different initial foot structure is rather powerful confirmation of this approach.

In summary, we have seen that an adequate account of apparently exceptional data in Damascene Arabic stress requires a theory of foot structure in which the terminal elements are, in effect, moras and heavy final syllables are incorporated into the foot. Cyclical assignment of foot structure by both a regular and a morphologically-restricted stress rule have also been motivated, and a metrical analysis of cyclical effects on word syncope has been offered.

NOTES

1I have discussed various earlier versions of this work with Morris Halle, Alan Prince, and Ellen Woolford, for which I am grateful. I acknowledge the assistance of Chias Barakat in confirming data in this article.

The symbols of the transcription system used here have the usual values with the following exceptions. \( \hat{a} \) and \( \hat{b} \) are the voiced and voiceless pharyngeal glides, respectively. \( \hat{\beta} \) is a voiced velar spirant. The subscripted dot in \( \hat{\alpha}, \hat{\beta}, \hat{\gamma}, \) and \( \hat{\delta} \) indicates pharyngealization, also known as emphasis. The symbol \( \hat{\circ} \) covers a fairly wide range of vowel quality. It is heavily influenced by adjacent consonants.

2Actually, Halle and Vergnaud (1978) offer a somewhat different account of superheavy syllables from the one given in the text. The differences have no consequences for the argument here.

3Prince (1980) provides a simple phrase-structure grammar that can yield feet with just the characteristics of (10).
from languages not treated by Halle and Vergnaud (1978). Thus, the need for this stipulation is orthogonal to the points at issue here.

Hayes (1979) describes the Damascene foot in somewhat different terms that are essentially equivalent to (15). The differences do not bear on the question of extrametricality.

The treatment of final CVV syllables in this dialect cannot be used to distinguish between these theories because it remains something of a research problem. The facts are as follows. First, there is no surface constraint of final vowel length without a concomitant stress contrast: 

*ḥabī 'he forgot', ḥabī 'he forgot him'. Second, final long vowels have a highly restricted surface distribution by morphological criteria. They occur only in vowel-final stems to which has been appended the third person masculine singular pronominal suffix: 

*darkašu 'you (pl.) studied'; 

darastušn 'you (pl.) studied them'; 

*baša 'he built', baša 'he built it'; 

*bašaš 'your (m. sg.) brother'; 

*wašas 'behind you (f. sg.)'. 

This cluster of facts is compatible with a number of theoretically different but empirically equivalent analyses, none of which seems to relate directly to the overall issues of Damascene accentuation.

These surface distributional facts are complicated further by the lack of an underlying contrast in quantity of final vowels except in the suffix forms above. Thus, a stem-final vowel is always short, except when followed by any pronominal suffix, in which case it is always long:

*darkaš 'you (pl.) studied them'; 

*baša 'he built it (f.)'; 

*bašaš 'your (m. sg.) brother'; 

*wašaš 'behind you (f. sg.)'. 

This cluster of facts is compatible with a number of theoretically different but empirically equivalent analyses, none of which seems to relate directly to the overall issues of Damascene accentuation.

The forms in (17) and subsequent examples abstract away from a late and somewhat variable expression process, described in detail by Cowell (1964).

This condition prohibiting the assignment of a foot to a single syllable could also be formulated as a rule of defooting, a restructuring rule along the lines of Selkirk (1980).

Another empirical difference in principle between the theories with and without primitive ternary feet lies in predictions about the iteration of foot assignment across the word. The theories of McCarthy (1979a, b) and Halle and Vergnaud (1978) predict that maximally ternary feet can alternate, giving a potentially acyclic stress secondary stress pattern in Damascene. The theory of Hayes (1979), which marks only the final syllable as extrametrical, alternates maximally binary feet, predicting a potentially trochaic pattern.

Neither prediction is testable in Damascene Arabic. I have seen no compelling observations of secondary stress nor is it apparent on listening. Some inferences by Allen (1973) on secondary stress assigned by the formally similar Classical Latin stress rule, however, support the ternary foot. From the congruence of itus and accent in early verse, he concludes that the full stress rule reappears across the word: 

*ritsonthus, *scheplochbar, 

*vilcosissima, *málláchus, *miséródria, *haddámia, *Cáprimandifats (from Allen 1965). If this is correct, then it is inconsistent with extrametricality as the sole source of ternary feet.

For unknown reasons two noun patterns, exemplified by *bàflet 'party' and *bàfelet 'company', are not subject to this variation. They invariably have constructs in *et.

This stress derivation requires a slight revision of the rule creating the superheavy syllable structures in (6). We must permit such structures finally on any cyclic domain rather than just finally in a word.

Of some interest is the behavior of the pronominal suffixes *thom 'them' and *the 'her'. The h is optionally deleted postconsonantly, 

*dakkaš 'he remembered they' and 

*dakkaš 'he remembered them'. Reconstruction of the suffixes as *ar and *ar yields occasional stress variants like *biv'éfə 'he will wait for them', 

with antepenultimate stress but as yet without syncope of the vowel in the penult.

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In this paper an analysis of primary and secondary stress in Cairo Arabic is presented. The system is seen to be one which counts syllables and functions in accordance with certain rhythmic principles. A morphologically conditioned stress rule is also discussed.

1. Stress in Arabic

Stress in Arabic, whether Classical Arabic or the modern dialects, is, for the most part, perfectly predictable in terms of syllable weight. Let us consider stress in Classical Arabic before turning to Cairene.

In Classical Arabic a CV syllable is light and CVV or CVC syllables are heavy. CVVC and CVCC syllables occur only in pauses. The rules usually given for Classical Arabic are the following:

Statement I: Stress does not fall on the last syllable, whether it be heavy or light.

Statement II: Stress falls on the last heavy syllable in a word.

Statement III: If a heavy syllable does not occur, stress falls on the first syllable of a word.

These statements may be illustrated by the following forms from Classical Arabic:

a. Stress on Last Heavy Syllable

<table>
<thead>
<tr>
<th>Word</th>
<th>Stress Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>ki.t3a.b+un</td>
<td>'a book'</td>
</tr>
<tr>
<td>mu.dar.fi.su+pua</td>
<td>'teachers'</td>
</tr>
<tr>
<td>3aa.l1.b+3a.t+un</td>
<td>'students'</td>
</tr>
</tbody>
</table>

b. Stress in Words without Heavy Syllable

<table>
<thead>
<tr>
<th>Word</th>
<th>Stress Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>ra.ja.9+a</td>
<td>'he returned'</td>
</tr>
<tr>
<td>ku.tu.b+un</td>
<td>'books'</td>
</tr>
</tbody>
</table>

Sources differ in their treatment of forms of more than three syllables. Some, for example, Abboud, et al. (1968),