On Foot Typology

ON FOOT TYPOLOGY*

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1. Preliminaries

The basic tenet of a metrical theory of stress has been to generate a finite set of structures from a fixed set of parameters which, on one hand, captures the variety of stress systems in natural languages, and on the other, predicts what systems would be impossible. Metrical structures were assigned by parsing algorithms which group syllables together to form feet. In what we may call the standard version (Halle & Vergnaud 1978, Hayes 1981), the parameters required to build feet were considered to be symmetrical. The crucial parameters are given in (1):

(1) I Tree form

Magnitude: bounded/unbounded
Headedness: left/right
Quantity sensitivity: y/n
Obligatory branching: y/n

II Rule application

Iterative: y/n
Directionality: left/right

III Extrametricality: segment (V/C/X), syllable, foot

In addition, a number of auxiliary notions are required to handle particular systems, viz. destressing and stress shift rules and a labeling rule which is sensitive to branchingness of nodes (LCPR). Extrametricality creates ternary feet but only at edges. The basic foot types that can be generated by these parameters are as follows:

```
(2)            bounded (or binary)          unbounded

               LH                  RH       LH                RH
             |------------------------|
             | f                   f  |     f                    f
    QI       | | \               / |  |     | \ \ \      / / / |
             | s  s              s  s |     s .... s     s ... s
             |                        |
             | f                   f  |     f                    f
    QS       | | \               / |  |     | \ \ \      / / / |
             | s  l              l  s |     s  ... l     l ... s
             |------------------------|

               f                   f        f                    f
    QS/OB      | \               / |        | \ \ \      / / / |
               h  l              l  h       h  ... l     l ... h
```

f: foot
s: any syllable
l: light syllable (= [m], i.e. monomoraic)
h: heavy syllable (= [m m], i.e. bimoraic)
LH: left-headed
RH: right-headed
QI: Quantity insensitive
QS: quantity sensitive (recessive node must be l=light)
QS/OB: QS plus obligatory branching (dominant node must be h=heavy)

In a more recent proposal, Hayes (1987) suggests that over and above the problem of requiring additional formal devices, this set of parameters generate structures that are either rare or clearly absent. He claims that particularly problematic in the bounded systems are the right headed quantity insensitive feet, which are rare, and the left headed quantity sensitive feet, which are totally absent. The few RHxQI cases which are attested can be reanalyzed in terms of LHxQI, with increasing complexity in the analysis reflecting their rarity. Hayes proposes to eliminate the parameters Headedness (L/R) and Quantity sensitivity (y/n) and to "replace them with an asymmetrical inventory of basic metrical units", as in (3):

(3) Syllabic trochee

```
     (x  .)              (.)
      s  s    otherwise   s
```

Moraic trochee

```
     (x  .)       (x  .)    (x)             (.)
      m  m   =   [ l  l or   h ] otherwise   l
```

Iamb

```
                 (.  x)                (x)      (.)
                  l  s    otherwise     h  or    l
```

Although the introduction of stressless feet may appear strange at first, it actually restores an old metrical principle which got lost at some point, viz. that stress presupposes a relation. A single element cannot be strong with respect to something else.

As pointed out in Hayes (1987), the asymmetrical nature of the inventory reflects a fundamental principle of rhythmical organization: equal units are always grouped in left-headed (trochaic) constituents, whereas unequal units are grouped in right-headed constituents. Systems of the latter type are iambic. Hayes' requirement is that heavy syllables may not occur as recessive nodes. In such systems, then, feet containing equal units need not be trochaic.

This formulation, given the arguments Hayes uses, seems indeed a desirable system. A change in foot inventory, similar to Hayes, has also been proposed by McCarthy & Prince (1986). M&P distinguish between two basic foot-types:

(4) M&P foot-types

Balanced	[u u]	Unbalanced	[v w], w>v
a.	[s s]		[l h]
b.	[m m]= [h] or [l l]		

For both Hayes and M&P, iambic systems are predominantly quantity sensitive. Trochaic feet are usually built on symmetric units - on syllables (for quantity insensitive systems) and on morae (for quantity sensitive systems).

One important difference between the two proposals is that M&P separate labelling from grouping, whereas for Hayes, both come together. The basic grouping principle is that unequal units group such that the heavier element comes last. In a system of this type all right-hand elements are strong - the labelling, in M&P's terms, would be uniform. If the labelling is not uniform, then for [A B], B is strong iff B > A, otherwise A is strong. Note that this is very similar to the LCPR.

Furthermore, M&P do not take recourse to stressless feet. Nonetheless, details aside, the two proposals are very similar.

To recapitulate, in Hayes's new system, QSxLH bounded feet would be captured by the moraic trochee. It is not immediately obvious how the traditional OB feet could be handled given these set of parameters. Recall that OB bounded feet essentially are a subset of the QS feet where the head must dominate a heavy syllable. This is precisely the type of feet, viz.

```
(5)          (x .)
              h l
```

that Hayes disallows. Only a monosyllabic foot may be built on a heavy syllable. Be that as it may, within this framework, ALL left dominant systems which are inherently quantity sensitive need to be parsed by the moraic trochee. From the foot-types that are generated in this framework, it seems apparent that languages with fixed inital stress (assigned to both heavy and light syllables) would make use of the syllabic trochaic system, since the moraic trochee would skip over an initial light syllable and mark it stressless. The obvious conclusion that one draws from this, is that languages with syllabic trochaic feet should not make use of syllable weight, and indeed Hayes refers to this fact in his paper. Extending this argument one step further, if one assumes that metrical structures are not merely designed for stress assignment, but may play a role in other phonological processes, it should be the case that languages using syllabic trochaic feet should not have segmental processes where quantity plays a major role.

In the light of these recent proposals, in the following sections we will reconsider systems which have been originally argued to be QSxLD but are known to have fixed stress. First, we will show that these proposals, as they stand, cannot directly account for such systems. We will then argue in favour of an analysis which assigns main stress first, and then constructs moraic trochaic feet, thereby unifying the apparently contradictory phenomena of quantity sensitivity and fixed initial stress.

2. The Germanic Languages

The older Germanic languages (Gothic, Old English, Old High German and others) are known to have fixed initial stress. With no additional information, one might consider such a language to be a quantity insensitive system. It is apparent, however, that there are segmental processes sensitive to metrical structure, which clearly indicate that quantity plays a role in these languages.

The two best known phonological processes which are sensitive to weight, are high vowel deletion (HVD) in OE, and Sievers' Law, which had an effect on all the Germanic languages. Examples showing the effect of HVD are given under (6):

(6) Old English HVD:

```
     /werud+u/  /good+u/  /word+u/  /heafud+es/  /lof+u/
           |          |         |        |
HVD        0          0         0        0           -
       werud        god      word     heafdes      lofu
```

In OE the high vowel [u] is deleted in the words word, werud, good and heafdes, but NOT in lofu. Before we discuss this in detail, consider the effect of Sievers' Law in some Gothic words.

(7) Sievers' Law in Gothic

```
     /sookjis/  /mikiljis/ /sipoonjis/ /glitmunjis/
          |          |          |            |
SL        i          i          i            i
      sookiis   mikiliis   sipooniis   glitmuniis


     /nasjis/ /stoojis/

SL       -        -
    nasjis    stoojis
```

In the examples given above, the glide [j] is vocalized in sookiis, mikiliis, sipooniis, and glitmuniis, but NOT in nasjis or stoojis. (The glide must be preceded ·by an onset - cf. stoojis where [j] is retained). Traditional accounts have always noted that for both SL and HVD to apply, the preceding context must be either a heavy syllable (long vowel or closed), or a sequence of two light syllables. The relevant metrical domain is, however, more complex. Notice, for instance, that in the word sipooniis, the sequence of syllables preceding the glide is [L H]. One solution would be to say that it is only the preceding syllable that counts - but we already know that this is false, since a sequence of LL counts as heavy. Moreover, words like glitmuniis, which have a sequence of [H L] syllables before the glide, also undergo SL. The literature covering the research on these complex issues go back to more than a century. Due to lack of space, our discussion of earlier research will, by necessity, be restricted to only two of the most recent proposals made in the literature which make direct reference to standard parametric metrical structures.

2.1 Recent metrical analyses of Germanic

The two recent relevant (but conflicting) metrical analyses which take into account both stress and segmental processes, are those of Keyser & O'Neill (1984) and Dresher &Lahiri (1986). To account for HVD in OE, K&O propose two different sets of metrical structures - an unbounded left dominant word tree to obtain stress, and a bounded right dominant QS foot for the segmental processes. Thus, OE /werudu/ would have the following different metrical structures:

(8) K&O metrical structures for HVD and stress

```
        F    F                W
       / \   |             /  |  \
          .  .             .
      R   R  R             R  R  R
      |   |  |             |  |  |
    C V C V C V          C V C V C V
    | | | | | |          | | | | | |
    w e r u d u          w e r u d u
                |
  HVD           0        STRESS
```

Although this analysis does succeed in unifying the various contexts in which HVD applies, it has several drawbacks, the most important of them being the necessity of having both iambic and right dominant metrical structures in the same language[1]. In contrast, Dresher & Lahiri argue that it is possible to capture both stress and the segmental facts by a single coherent metrical analyses. This approach has the advantage of recognizing throughout the dominance of the initial syllable - an undisputed fact of Germanic prosody - and as a consequence, does not treat metrical structures as mere counting devices. The foot proposed by D&L is quantity sensitive left headed and obligatory branching; it is <u>not</u> however the traditional OB foot where the head must dominate <u>a</u> heavy syllable. Here, the head of the foot must at least dominate two morae, but if the rime of the first syllable contains only one mora, the second mora can be obtained from the next syllable. The head of the foot is labelled a sub-foot and it can therefore dominate (l l), (h) and also (l h) syllables. Some relevant metrical structures in D&L's analysis are given in (9) :

(9) f= sub-foot
F= Foot
Old English : HVD

```
       F           F           F    F       F
      / \         / \         / \   |       |
     /   |       /   |       /   |  |       |
    f    |      f    |      f    |  |       f
   /\    |     / \   |     / \   | / \     / \
   m m   m     m  m  m     m m   m m m     m   m
  w o r d u  w e r u d u  h e a f u d e s   l o f u
         |           |           |
  HVD    0           0           0
```

Gothic: Sievers' law

```
   F      F      F      F      F      F
   |      |      |      |      |      |
   |      |      |      |      f      |
   f      |      f      |     / \     |
  / \    / \    / \    / \   /  /\   / \
  m m    m m    m  m   m m   m  m m  m m
 s o o k j i s  m i k i l j i s  s i p o o n j i s
         |                |              |
 SL      i                i              i
```

```
      F          F    F
      |          |    |
      f          |    |
    /   \        f    |
   /    /\      / \  / \
   m    m m     m m  m m
 n a s j i s  s t o o j i s

 SL   -            -
```

In OE, the high vowel is deleted when it is in the weak branch of F. The glide is vocalized when preceded by an onset, except when it is part of the sub-foot. For further details of this analysis please consult the original paper.

Although the sub-foot analysis provides a homogeneous analysis of <u>all</u> the Germanic data, stress as well as segmental processes, Dresher & Lahiri do not explicitely address the issue of how the foot-type they propose, fits into the universal foot typology. Recall that the closest it comes to is the traditional QSxLDxOB foot, where the first syllable MUST be incorporated into the head of the foot, even if it is light. Is it possible, given the new Hayes (1987) foot structures, to account for Germanic?

2.2 Germanic and the revised parametric approach

The combination of quantity-sensitivity and a metrically strong initial syllable, suggests that the most likely choice for Germanic, is the moraic trochee. Moreover, the metrical equivalence of LL and H found in Germanic, is exactly what Hayes wishes to capture with the moraic trochee. Let us first consider OE:

(10) OE - build moraic trochee from left to right

```
 (x)  (.)       (x   .) (.)     (x)  (x   .)    (x   .)
w o r d u      w e r u d u     h e a f u d e    l o f u
```

For the first two words, it appears that the high vowel is deleted when a stressless foot is built on it. In lofu, the vowel [u] is retained because it is part of a stressed foot. However, the structures built on the third word show that the vowel to be deleted, is actually the head of a foot. This problem could be circumvented by adding a destressing rule which would apply when two stresses fall in a sequence, making the second syllable stressless, and sensitive to vowel deletion. This, however, does not solve all the problems, because for words like lofum (the [u] remains) which should have main stress on the first syllable, the moraic trochee assigns an initial stressless foot. Compare the following nominative and dative plural forms of some OE words:

(11) OE nominative and dative plural forms

```
      word+u      word+um       lof+u      lof+um
           |
 HVD       0         -             -          -
    word        wordum        lofu       lofum
```

moraic trochee built on the above words:

```
  (x)   (.)     (x)   (x)     (x    .)    (.)  (x)
 w o r d  u    w o r d u m    l o f u    l o f u m
```

To permit the initial syllable of lofum to get stress, one could make the final segment extrametrical so that there would be two light syllables, just like lofu. Unfortunately, this forces the final [m] of wordum to become extrametrical too - wordu(m) - making it now identical to the nominative and therefore eligible for HVD.

The moraic trochee is indeed intended to provide a distinction between (l l) and (l h) syllable sequences, and is therefore unable to assign correct structures for Germanic words, where in both instances the first syllable has to be metrically strong.

The same problem holds for Gothic. Any time an initial light syllable is followed by a heavy syllable, there is a problem, since the trochee can have a branching foot on two morae of two light syllables, but cannot form a foot by borrowing a mora from the second syllable, if it is heavy. Moraic trochaic feet built on these words would give the structures under (12). Note that again *nasjis* and *sipooniis* end up with initial stressless feet.

```
(12)    (.)   (x)        (x)   (x)      (x   .)    (x)
       n a s j i s    s oo k j i s    m i k i l j i s
                             |                   |
     SL     -                i                   i

            (.)  (x)    (x)
           s i p o o n j i s
                       |
     SL                i
```

Again, for the sake of argument, we may assume that the final segment in *nasjis*, is extrametrical making it a sequence of two lights giving a foot of the type (x .). This cannot work for *sipooniis*, where final segment extrametricality does in no way prevent a stressless foot being built on the initial syllable.

An alternative way of dealing with this problem has been to argue for syllable-based analyses which claim to have special syllabification strategies in Gothic making [nasjis] syllabify as [nas.jis] since the first syllable bore stress (Murray and Venneman 1983, Lahiri 1982 and others). Arguments against this are enumerated in D& L. The important point is that even if a special syllabification strategy works to get the Gothic stress facts correct, it obtains the exact opposite results for *lofu* and *lofum* in OE. The former should then be be syllabified as *[lof.u]*, making it exactly the same as [wor.du] and therefore subject to vowel deletion.

2.3 An alternative approach

Recall, that the need for the D&L OB foot structure is not just to be able to get the inital syllable stressed, but also to be able to capture the quantity facts for the segmental processes. The role of quantity in Germanic is varied. First, there is the metrical equivalence of a single heavy to two light syllables, a phenomenon common in many languages. In addition to this, what is special in Germanic, is the fact that it is not just two lights which can form a foot, but an initial light first syllable (which has to be metrically strong) can be grouped with the following syllable, be it light or heavy, into the head of the foot, which in D&L's terms is called a sub-foot.

There is nothing directly available in the foot typology in Hayes's recent proposal (nor in M&P), that achieves the same results as the D&L foot type, which is necessary to capture the facts in Germanic. The closest we come to, is the moraic trochee, but this needs to be somewhat adapted, such that an initial light syllable can "borrow" a mora from the next syllable, even if this syllable is bimoraic. Such a move would only make sense if the initial syllable was already strong. Thus, to incorporate the sub-foot analysis proposed by D&L within a framework such as the one proposed by Hayes, the most obvious move would be to obtain the desired results in two steps.

First, build a non-iterative foot on the first syllable on which stress is assigned. This makes the first syllable metrically strong, be it light or heavy. The second step involves foot construction. Clearly, Germanic is quantity-sensitive, left dominant, with a metrical equivalence of one heavy and two light syllables. Accordingly, the most appropriate choice is the moraic trochee, except that in this case, the foot construction <u>must</u> incorporate the already strong initial syllable. Recall, that the initial stressed syllable could be light or heavy, and normally a light syllable could be the head of a moraic trochee only if it was followed by another light syllable. This is where Germanic differs - this initial metrically strong syllable <u>must</u> be head of a foot, even if a heavy syllable follows. We suggest that the only way this can be done, is to borrow a mora from the following syllable, a process, which on one hand, strengthens the initial syllable, and on the other, decreases the weight of the second syllable. Let us consider the derivations of the most problematic cases.

(13) Gothic OE

```
    s    s       s       s    s
    |   / \     / \      |   / \
    m   m m     m m      m   m m
  s i p o o n j i s    l o f u m

stress
-->
   (x)                  (x)
    s    s       s       s    s
    |   /\      /\       |   / \
    m   m m     m m      m   m m
  s i p o o n j i s    l o f u m
```

```
MT
-->
   (x    .)     (x)       (x    .)
    s    s       s         s    s
    |`.,/ \     / \        |`.,/ \
    m   m m     m m        m   m m
  s i p o o n j i s       l o f u m
```

In essence, we have an ambisyllabic mora to add strength to the preceding syllable, but taking away in weight from the syllable to which it was originally joined. Note that it is not the consonant which becomes ambisyllabic but the unit of weight[2].

At this point, one may ask that if main stress is assigned first, is it necessary to go through this elaborate procedure of making a mora ambisyllabic? It seems that we have two choices. The first option is to take an approach similar to that of K&O and opt for two different sets of metrical structures . Such a move appears to be clearly undesirable and only to be tolerated as a last resort. The second choice is to ignore the initial stressed syllable for the purpose of foot construction. Thus, the moraic trochee is built from the second syllable onwards. The pertinent question is, of course, how necessary is this ambisyllabicity. Let us briefly consider the alternatives.

The relevant words are those which have an initial light syllable. If we assume that the stressed syllable is strong, and begin foot construction from the second syllable, we would get the following structures for the Gothic pairs nasjis and sookiis, and OE lofu and wordu:

```
(14) MS   (x)        MT   (x)      (x)
         n a s j i s --> n a  s j i s
        s oo k j i s --> s oo k j i s

     MS   (x)      MT    (x)  (.)
          l o f u  -->  l o  f u
        w o r d u  --> w o r d u
```

This cannot be right since it makes nasjis eligible for Sievers' Law and lofu should lose its final vowel. One way out would be to say if the first syllable is light, the second syllable may be incorporated into the trochee if it is possible - and this can only be possible if the second syllable is light. This enables lofu to be parsed as (x .), but a single foot can be built on nasjis, only if the final segment is extrametrical; then, the glide would not vocalize if it was part of a stressed foot. Note that extrametricality can be used only for Gothic and not for OE since that would make the final segment of words like wordum sensitive to HVD (cf section 2.2). Although these patch-up methods allow us to derive the correct forms, we miss a fundamental generalization, that on the level of metrical description, words like lofum and wordum (which would both be parsed as [(x) (x)]) are not equivalent. Evidence for this comes from the West Germanic rule of gemination, which geminates obstruents when followed by a glide and preceded by stressed light syllables.

(15) WGmc gemination

```
  OE /bedjes/ -> beddes  genitive
     /bedje/  -> bedde   dative
but
     /wiitjes/-> wiites
     /wiitje/ -> wiite
```

As D&L show, gemination occurs within the sub-foot, where the sub-foot dominates both /bedjes/ and /bedje/. In the present analysis, we would capture this fact by assigning main stress first, and built the moraic trochee, strengthening the initial syllable by taking a mora from the next syllable:

```
(17)     (x)        MT  (x       .)
          s      s        s      s
          |     / \       | `` ./ \
          m     m m       m     m m
        b e d j e s  -> b e d j e s

         (x)        MT  (x     .)
        b e d j e    -> b e d j e
```

If we did not allow ambisyllabicity, these words would have different structures. And recall, segment extrametricality is impossible because otherwise wordum would become subject to HVD.

3. Conclusion

In this paper, we propose an analysis to handle language systems with fixed initial stress within the framework proposed in Hayes (1987), which proves to be eminently desirable for several independent reasons. A metrically coherent analysis, accounting for the entire set of Germanic data, has been recently provided by Dresher & Lahiri (1986). The metrical structures generated in this proposal (especially the sub-foot), however, cannot be handled directly by the inventory proposed by Hayes. The underlying principle of the sub-foot is that a stressed syllable must have two morae. This requirement is satisfied if the initial syllable is heavy; otherwise a second mora must be borrowed from the following syllable, be it light or heavy. To capture this formulation, we suggest that stress is assigned first, making the initial syllable metrically strong; then, build a moraic trochee (which, as Hayes points out, deals with normal QSxLD systems) including the initial syllable. However, the basic idea behind the moraic trochee is that the recessive node cannot be heavy. Therefore, to build a bisyllabic foot, where the first initial syllable is light but the following one is heavy, a mora from the second syllable is linked on to the first syllable, strengthening the latter and weakening the former.

The suggestion to assign main stress BEFORE rhythmic melody has already been made in van der Hulst (1984). In this proposal, in discussing the relationship between main stress and secondary stress, van der Hulst argues that instead of assigning alternating stresses first and then main stress, main stress is assigned first and the alternating stresses are echos of the main stress. The languages discussed under this hypothesis are the traditional quantity sensitive unbounded systems. However, given our analysis of Germanic, this proposal can be extended to languages which appear to have stress assigned like QI systems but where quantity does play a role in segmental processes.

This opens up a range of questions regarding quantity sensitivity of systems. How often do languages with fixed peripheral stress make use of metrical structures in other processes? If so, does quantity play a productive role and would it be the case that such languages behave like Germanic? If we are to maintain a theory of metrical coherence and build metrical structures following the general principles that Hayes has spelt out for independent reasons, we need to assign main stress before building QS structures in languages like Germanic.

FOOTNOTES

*This paper is excerpted from a larger work in progress.

1. K&O's rule of HVD states that a high vowel in an open syllable is deleted when <u>followed</u> by a foot. Please refer to D&L for further discussion concerning this rule.

2. To delete the second vowel in <u>heafude</u>, we will still require a destressing rule so that [u] is <u>no longer</u> head of a foot.

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