Interfaces

Bydgoszcz Studies in Language, Mind and Translation

Edited by Anna Bączkowska

Tomasz Ciszewski

The Anatomy of the English Metrical Foot

Acoustics, Perception and Structure

PETER LANG EDITION

1. The foot in phonological theory: an overview

1.1 Introduction

In this introductory chapter we shall provide an overview of the past research on stress and rhythm which refer to the concept of metrical foot. First, the definitional misconceptions will be discussed (1.2). Then, we proceed to a brief summary of theoretical proposals concerning pedal structure in Metrical Phonology and Government Phonology (1.3). Functional arguments for the foot structure will be discussed in (1.4); in (1.5) further extralinguistic evidence will be reviewed. Finally, we will critically discuss 'footless' approaches to stress and rhythm.

1.2 Definitional problems

Although the concept of the metrical foot has been widely used in the phonological literature, little attention has been devoted to formulating a properly constrained formal definition that could be empirically testable at the same time. Most of the definitions available so far (Abercrombie 1967, Hayes 1995: 40, Giegerich 1992: 181) refer to the traditional notion of the syllable (which, however, is in itself highly disputable, both phonologically and phonetically, cf. Dziubalska-Kołaczyk 1999) and the idea of an interstress interval (cf. Fant, Kruckenberg and Nord 1989) whose boundaries were assumed to coincide with the onsets of stressed syllables. It seems likely that the persistent definitional problem has its sources in the original poetic usage of the term, whereby the foot is used as a cover term for all sorts of interstress intervals within a rhythmical piece of poetry. Rhythmicity in poetry, however, is arrived at rather artificially and results from a conscious artistic manipulation of lexical and syntactic structure, subordinated to the intended semantic result. As such, it is quite different from a (potential) rhythmicity of naturally produced language. Thus, it should not be taken for granted that the poetic and the linguistic stress feet are identical in terms of size, internal structure and the acoustic characteristics of their components.

However, most phonological approaches seem to tacitly rely on the assumption that foot heads (i.e. stressed elements, be it whole syllables, syllable rhymes, nuclei, or moras depending on the framework) share the same, formal and/or acoustic properties and, what seems even less empirically grounded, that the universal foot template is syllabically/moraically binary (Hayes 1995: 71). It is the latter assumption in particular that has led to a lot of *ad hoc* theorising, i.e.

extrametricality rules in Metrical Phonology (Hayes 1995, among others) or the 'superfoot' (Selkirk 1980, Harris 1994, among others), whose aim was to cater for ternary stress patterns through binary footing. The dogmatic insistence on binarity in Optimality Theory and Government Phonology, on the other hand, results in disregard for the data that do not support universal foot binarity.

As observed by de Lacy (2007), the strong theoretical predictions are usually based on empirically poor and impressionistic data. Unfortunately, this also refers to English. Despite abundant literature on the formal aspects of the English foot structure, its acoustic properties remain largely unexplored. Before we proceed to the analysis of acoustic data, however, we shall first briefly overview the history and the application of the concept in phonological theory.

1.3 The foot in phonological theory

Until 1970's phonological research concentrated mostly on the idea of 'distinctiveness'.The 'distinctive' bias successfully blurred the picture of phenomena, e.g. stress and rhythm, for which the distinctiveness is not of paramount importance. Since certain phonemes may carry stress, whereas others may not, the conclusion was drawn that stress, similarly to nasality for instance, is a distinctive feature of phonemes (e.g. Macélot 1960).Though the analysis of which features of a phoneme are phonologically relevant (distinctive) is crucial for describing sound patterns of a language, it does not necessarily entail a conclusion that all simultaneously realised features must be included in the description of a particular phoneme. For instance, the Russian words ˈ*muka* vs. *mu*ˈ*ka* (Eng.: *torment* vs. *flour*) do not contrast because of a phonemic commutation, but because of the position of stress. In this sense stress is fundamentally different from duration or tone, which are prosodic features. Thus, it is incorrect, according to Garde (1967) to classify stress as a prosodic feature of phonemes or syllables, on a par with duration or tone. The latter, together with inherent distinctive features are 'sub-types' of distinctive features. Stress seems to fall beyond this classification.

A radical breakthrough in approach and research priorities came in 1970's and had its sources in research on tonal languages which undermined the monolithic nature of segmentally-based phonologies. Wang (1967) suggested to raise tones to the status of syllabic rather than segmental features. His proposal generally passed unnoticed, perhaps due to the fact that similar results were obtained if tones were subordinated directly to vowels. What remained problematic to both analyses were contour tones occurring within a syllable containing a short vowel, since this phenomenon could not be accounted for by means of feature comprising a single segment. Leben (1971) has shown experimentally that contour tones do occur within indivisible syllable nuclei, which suggested that the domain of a contour tone may be a unit smaller than a segment; hence, a conclusion that segments have an internal temporal structure. Leben also showed that a single tonal specification may spread over more than one segment or syllable sequence. It was not until 1976, however, that Goldsmith proposed a groundbreaking, full-bodied theory of Autosegmental Phonology. Concurrently, Lieberman (1975) questioned the binarity of stress as a feature of segments, suggesting instead to treat stress as a derivative of grouping phonemic sequences into metrical feet. These analyses paved the way for a genuine breakthrough in the analysis of stress, which came with the Liberman and Prince's (1977) theory of Metrical Phonology.

1.3.1 Liberman and Prince (1977) vs. Prince (1983) and Selkirk (1984)

Metrical theory of stress emerged as a reaction to less-than-successful SPE-like analyses of linguistic stress and rhythm. A common feature of metrical and autosegmental phonologies was an attempt to find alternatives to non-local mechanisms in traditional generative model. Hierarchical representations were able to formalise operations on non-adjacent elements within a segmental sequence in a local manner on an appropriate level of representation. Central to this approach was capturing the hierarchical nature of stress in an arboreal-like representation (which was independent of distinctive feature matrices and was referred to as the 'metrical tree') in which every node/branch was defined as 'strong' or 'weak'. Since one of the typological properties of stress is its relativity, one node was weak only because the other was strong. Higher-level nodes also remained in the dependencyrelation 'weak/strong' which, however, was reverse. In this way different stress levels were captured within the same word.

Nonetheless, metrical trees, however, were unable to cater for the rhythmic distribution of stress, nor could they resolve the stress clash between two consecutive stressed syllables. Thus, Liberman (1975) proposed an alternativerepresentation referred to as 'metrical grid'.

(1) Metrical grid representation of the word *Alabama*

```
                *
*               *
*      *        *        *
A l    a    b   a    m   a
```

The height of a column corresponded to the prominence level of a particular syllable. In earlier versions of Metrical Theory the metrical grid was built on the basis of a metrical tree by means of a 'mapping rule', which superimposed the dependency relations between the branches of the same metrical tree.

Certain contrasts could not, however, be captured by means of metrical trees, e.g. ˈ*conˌtest* vs. ˈ*tempest*, for which metrical trees are identical even though their stress patterns differ. Metrical trees were indeed able to encode the relation between sister branches, but were unable to capture unambiguouslythe representation of the stressed syllable. Therefore, Liberman and Prince (1977) initially insisted on using the traditional [+stress] segmental feature. It was Selkirk (1980) who introduced to the theory the metrical foot constituent, in which the distribution of stresses was identical with the distribution head dominant elements.

Thus, the hierarchy of prosodic categories included: the syllable, the foot, and the prosodic word. The exhaustivity condition required that each syllable belong to the metrical structure. Since every prosodic word obligatorily dominates a metrical foot (which follows from the closed prosodic hierarchy),every word must have an accented syllable and thus obey the 'culminativity' condition. The proposals by Liberman and Prince (1977) were further developed by Prince (1976), McCarthy (1979), and Hayes (1980) in particular, who enriched Metrical Theory by postulating 'parameters', whose aim was to cater for various accentual systems.

The parameters, which could be set [OFF/ON] for a particular system, can be subsumed under two categories: (i) those referring to possible foot shape/structure and (ii) those referring to foot construction. The former category includes:

- **boundedness**: metrical feet can be bounded (i.e. exclusively binary) or unbounded (i.e. they may contain an unlimited number of syllables). Degenerate feet are justified only by culminativity and exhaustivity conditions, i.e. every content word must be dominated by a foot and no syllable may remain outside metrical structure.
- **dominance**: determines the location of foot heads. Thus, metrical feet may be left-headed (trochees) or right-headed (iambs). Universally, recessive branches may not themselves branch and all unmarked dominant branches are labelled as 'strong'.
- **quantity-sensitivity**: controls the distribution of heavy and light syllables in foot-peripheral positions. In quantity-sensitive systems there are no weight restrictions on foot heads, whereas in quantity-sensitive systems heavy syllables are not allowed under foot-recessive branches and are obligatorily stressed.

The construction parameters include:

- **directionality**: which controls the direction in which syllabic material is scanned during foot construction: right-to-left or left-to right.
- **iterativity**:in non-iterative systems words have only one metrical foot; its assignment stops further metrical parsing. Bi-directional systems arise as a consequence of non-iterative metrical parsing from one direction and iterative one from another.
- **branching**:metrical dominance parameter has two values: left-dominated or right-dominated. Unmarked convention designates dominating elements (syllables) as ‘strong’ and assigns the main stress to the peripheral foot. In marked cases, syllables may be strong (dominant) only if they branch, i.e. are prosodically heavy.

Additionally, Hammond (1982) introduced the parameter of metrical locality, according to which metrical rules may apply only to elements on the same or an adjacent level of metrical structure.

Central to Metrical Theory was the mechanism of extrametricality which was first postulated by Liberman and Prince (1977) and whose function was to (i) avoid the construction of problematic feet (rare, non-existent or larger than binary), (ii) explain the cross-linguistic avoidance of word-final stress and (iii) to mark exceptions to accentual rules. The mechanism of extrametricality guaranteed that no bounded feet larger than binary may be constructed (in which way the possible foot inventories wereheavily constrained).[1]Apart from theory-internal typological advantages, extrametricality was claimed to be a useful theoretical device for the description of more exotic, and apparently irregular, stress systems, like Hopi (Jeanne 1982) or was resorted to as a ‘marker’ of (fairly scarce) irregular stress patterns in Polish (e.g. *uniˈwersy<tet>*$_{EM}$), whereby the addition of an extraderivational syllable restores the regular penultimate pattern (*uniwersyˈtetu*). The fact that the final syllable *-tu* may not be treated as extrametrical was accounted for by another theoretical device, namely extrametricality erasure in morpheme non-final positions.

Hayes (1982) proposed a set of constraints on the apparently overproductive extrametricality rules. In particular, he proposed that extrametricality rules may only apply to phonological (i.e. segment, syllable) or morphological (affixes) entities. Furthermore, its application was restricted to peripheral positions (as independently argued by Archangeli (1984) for Yewelmani or by Franks (1985) for Polish) and is blocked if was to comprise the whole domain (e.g. a monosyllabic word). Hayes theory was essentially set within the lexical

1 Often with complete disregard for the data, e.g. English ternaries of the ˈ*Canada* type. For a more detailed criticism, see section 7.2.

phonology approach (e.g. Kiparsky 1979), which assumed that phonological processes apply cyclically after all morphological operations. Rowicka (1988) points out that the implicit ‘cyclic’ twist of metrical phonology was commonly accepted within the framework and defended on the grounds of secondary stresses distribution in derived words, where secondary stress position coincides with the main stress position in the corresponding non-derived word, a regularity which cannot be adequately accounted for in a non-cyclic fashion.

Further developments and refinements of metrical theory included de-stressing rules and stray syllable adjunction. These mechanisms were enforced by the overproductivity of stress assignment rules, which often led to the assignment of excess stresses. Such derivations had then to be doctored by de-stressing rules, whose aim was to remove the wrongly assigned metrical feet (=defooting). Frequently, de-footing resulted in representations which violated the exhaustivity condition and produced ‘stray’ (unfooted) syllables. This, in turn, required another mechanism which could restore metrical well-formedness through the so called ‘stray syllable adjunction’ or ‘stray erasure’ (Harris 1983).[2] De-footing, however, required yet another constraint (Hayes 1982), namely that it may not affect the main stress foot.

The accumulating body of theoretical complications (which were in fact maintained to be solutions to the representational and derivational problems) within the tree-based model of metrical phonology led to a return to earlier alternative proposals, like those by Prince (1983) and Selkirk (1984), who postulated a simplification of the standard model by eliminating the foot constituent, which in their opinion could be successfully replaced by the metrical grid representation. As argued by the proponents of grid-only representation of stress , the grid constituted a far more elegant representation for stress clash resolution and alternations. These proposals are critically reviewed in section 1.6.

The foot constituent was not abandoned for long, though. McCarthy and Prince (1986) pointed at strong empirical evidence for the foot structure, which proved indispensable for explaining stress shift and a number of morphological operations, like infixation or reduplication, as well as minimal word requirements. This retreat to pedal structure, however, did not entail a complete abandonment of the grid representation. Instead, the grid was appended with brackets whose function to mark foot boundaries.[3]

---

2 Should stray erasure erase a final mora, a special licensing mechanism was postulated to prevent the deletion (cf. Downing 1993, Everett 1996).

3 The bracketed grid representation shares some formal properties with the ‘arboreal grid’, as proposed by Hammond (1984, 1991) or Lerdahl and Jackendoff (1983).

1.3.2 Halle and Vergnaud (1987)

Halle and Vergnaud (1987) (henceforth HV) in their seminal *Essay on Stress* developed a theory of stress and rhythm based on the bracketed grid representation. They assumed a hierarchy of metrical grid levels and the foot constituents were constructed through bracketing of adjacent elements (syllables) on the same level. Line [0] brackets corresponded to foot boundaries in tree representations. Line [1] consisted entirely of foot heads which are projected from line [0]. The major advantage of this representation, similarly to that of Hammond (1984), is the simultaneous encoding of prominence, rhythm and pedal structure. Furthermore, the bracketed grid allows to freely formulate rules which move, delete or insert the asterisks on metrical grid.

HV's theory was a parametric one. They postulated the following parameters on foot structure: (i) boundedness, (ii) headedness, and (iii) directionality. Foot construction rules are referred to as 'Alternator' and are reminiscent of Prince's 'perfect grid' (Prince 1983). The Alternator operates in an exhaustive manner, which guarantees exhaustive syllabic parsing. Iterative assignment of foot boundaries is in HV's approach is a derivative of exhaustivity, which indicates that the iterativity parameter itself may be rejected. As far as the English stress system is concerned, HV (1987: 103) propose the following Alternator rules:

(2) a. Line 0 parameter settings are [+HT, +BND, felt, right to left]
b. Construct constituent boundaries on line 0.
c. Locate the heads of line 0 constituents on line 1.

In terms of quantity-sensitivity, similarly to Prince (1983),a special rule pre-assigns line [1] asterisk to every heavy syllable. Such parsing mode is controlled by the Faithfulness Condition. All bounded feet result from the application of Alternator rules.

HV analyse surface ternary feet through [+/-Terminal Head]. If the parameter value is negative an extra element may be footed between the head and the foot boundary. This may, for instance, result in the construction of an amphibrach foot ($*\underline{*}*$).

In most unbounded systems only one stress is phonetically realised, while the others remain potential. In a situation when two adjacent lines are conflated ('line conflation') the metrical foot is preserved only if its head is simultaneously the head on a higher line. Line conflation is also a mechanism which captures bi-directionality of parsing, namely the bi-directional systems may be described as resulting from the application of two exhaustive parsing rules of different directionality.