12 Metrics and phonological theory*

Bruce Hayes

12.1. Background

The field of metrics studies how conventionalized rhythmic patterns are manifested by phonological material in verse. Metrics and phonology are closely related fields whose interaction is yielding increasingly important results. This chapter outlines some of these findings, as well as directions for future research.

First, a caveat concerning what this chapter is *not* about. Metrics is only part of the larger field of poetics, which studies literature from the structural viewpoint adopted in linguistics. Excellent introductions to poetics may be found in Jakobson (1960) and Kiparsky (1973). I will also bypass work on metrics that is not focussed on the link to linguistic structure and to phonology in particular. The annotated bibliography of Brogan (1980) is recommended as a guide to such work.

A good place to start is to establish what questions linguists should try to answer in studying metrics; this defines the basic research strategy. To my mind the most compelling proposal has been the 'generative metrics' originated in the 1960s by Halle and Keyser (cf. Halle & Keyser 1969; Keyser 1969; and especially Halle & Keyser 1971). Generative metrics focusses on the problem of *well-formedness*. We assume that a meter is an abstract rhythmic form, internalized by those who command the relevant metrical tradition. Participants in a tradition share a tacit set of rules which determine which phonological sequences of their language constitute well-formed instantiations of a meter. Such sequences are termed *metrical*, while sequences excluded by the rules are termed *unmetrical*.

Consider an example. The English iambic pentameter can be represented roughly as a sequence of ten beats, alternatingly weak and strong: *w s w s w s w s w s*. The line by Shakespeare under (1a) would count as a metrical

* I would like to thank Matthew Chen, Morris Halle, Michael Hammond, Patricia Keating, S. Jay Keyser, Betty Jane Schlerman, and Moira Yip for helpful comments on an earlier version of this chapter. Responsibility for errors is my own.

instantiation of this meter in English, whereas (1b) would count as unmetrical.

```
(1)  a.  Beshréw that héart that mákes my héart to gróan     (Son. 133)[1]
          w    s     w    s     w    s    w    s    w   s
     b. *Then beshréw it, it provókes gróans dáily           (construct)
          w    s   w  s  w   s w      s     w s
```

Metricality is typically gradient: among the metrical lines, some are more canonical manifestations of the meter than others. For example, line (2), although hardly unusual for Shakespeare, is clearly a more complex instantiation of the iambic pentameter than (1a):

```
(2)  Príson my héart in thy stéel bósom's wárd               (Son. 133)
      w s    w s    w   s  w    s w      s
```

Halle & Keyser thus assume a 'complexity metric,' which is a set of rules determining listeners' judgements of how far a line deviates from the ideal.

From this perspective, the initial goal of metrics is to discover the rules that govern the metricality and complexity of verse in the metrical traditions of the world. Note that these rules, like purely linguistic rules, will normally be unconscious; poets often cannot explicitly state rules that they observe rigorously in their verse. Accordingly, generative metrists use as data actual corpora of verse. If a given phonologically normal sequence never appears in the corpus lined up with the meter in a particular way, it is assumed that that alignment is unmetrical.

Just as in lingustics proper, the attempt to write metrical rules explicitly has yielded interesting results. The rules underlying the world's metrical systems show a remarkable variety, richness, and intricacy. To give an idea of the kinds of system that have been investigated, I will summarize three rule systems that have been discussed in the literature. For reasons of length, the summaries are greatly oversimplified and in no way substitute for the original work.

I. *English iambic pentameter*, as composed by Shakespeare. I follow here Kiparsky (1975, 1977), who draws on work by Halle and Keyser, Magnuson and Ryder (1970, 1971), and others.

The abstract rhythmic pattern can be expressed using the tree notation of metrical phonology, as shown in Figure 1. The tree specifies that the pentameter pattern consists of five feet, each containing a weak followed by a strong position. The feet are grouped into cola, with the rightmost foot of each colon the strongest. A line consists of a weak two-foot colon followed by a strong three-foot colon.

[1] Abbreviations for Shakespeare titles follow Spevack (1973: xii). Text and line numbers are from the Riverside edition (Evans 1974).

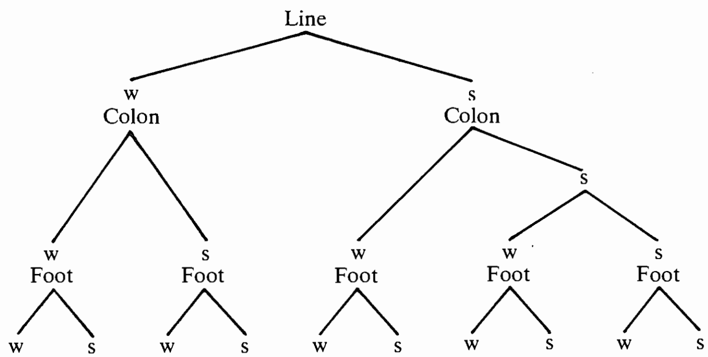


Figure 1. Rhythmic pattern for the English iambic pentameter

The 'correspondence rules' that determine when a line is metrical are as follows.

(3) *Syllable count*: Syllables correspond one-to-one with terminal nodes of the metrical pattern.

That is, pentameters have ten syllables. I ignore the numerous rules that allow exceptions to this.

(4) *Phrasing*: Line boundaries must coincide with phonological phrase boundaries.

(5) *Rules governing stress*
a. The '*Monosyllable Rule*'
A stressed syllable must occupy *s* position unless:
(i) it consists of a single, monosyllabic word; or
(ii) it immediately follows a phonological phrase boundary.
b. At the right edge of a phonological phrase, the sequence *stressless–stressed* must occupy *ws* position.

These rules admit as metrical canonical lines like (1). However, they permit Shakespeare a great deal of flexibility in writing lines that do not so directly reflect the rhythmic pattern. In the following lines, relevant phrase boundaries are marked with [/].

(6) a. When to the séssions of *swéet* sílent thóught (Son. 30)
w s w s w s w s w s
b. Or how *háps* it I séek not to advánce (1H6 3.1.31)
w s w s w s w s w s
c. Resémbling stróng *yóuth*/in his míddle áge (Son. 7)
w s w s w s w s w s

d. To sée thy Antony/*máking* his péace (JC 3.1.197)
w s w s w s w s w s

In (6a), the stress on *sweet* is mismatched, but the line is metrical because *sweet* is monosyllabic (5a.i). Line (6b) is metrical for the same reason. In (6c), *youth* bears a mismatched phrase-final stress, but the line is not ruled out by (5b), because *youth* is preceded by a stressed syllable. In (6d), the stressed syllable of *making* would violate the Monosyllable Rule, except that it immediately follows a phrase boundary (5a.ii).

Lines like those of (6) are not at all uncommon in Shakespeare. But lines that violate the rules of (5) are essentially missing from the corpus. This holds true even for lines that superficially sound much like the metrical lines of (6):

(7) a. *When in the cóurse of *seréne* sílent thóught (construct)
w s w s w s w s w s
b. *As it *háppens* I séek not to advánce (construct)
w s w s w s w s w s
c. *Resémbling *a yóuth*/in his míddle áge (construct)
w s w s w s w s w s
d. *To sée that Brútus/is *máking* his péace (construct)
w s w s w s w s w s

Thus while lines (7a) and (7b) have the same stress patterns as (6a) and (6b), they are excluded by the Monosyllable Rule. In (7c), the sequence *a youth* violates rule (5b). Line (7d) violates the Monosyllable Rule as, unlike in (6d), the word *making* does not follow a phrase boundary.

The size of the Shakespeare corpus is such that the absence of lines like those of (7) cannot be accidental. The rules of (5) must approximate the tacit principles Shakespeare used in deciding what lines 'sounded right' as iambic pentameters.

Further evidence in support of this comes from other poets. Kiparsky (1977) has shown that various English poets differ substantially in the rule systems that govern their metrical practice. The differences are far greater than what might be expected, given the similar overall 'feel' of the verse. Thus, for example, Shakespeare and Milton each wrote lines that would count as unmetrical in the other's system. Cases of this sort again suggest that the absence of lines in the Shakespeare corpus that violate Shakespeare's rules cannot be an accident.

The rules that govern complexity in Shakespeare (degree of divergence from the ideal among metrical lines) should also be mentioned. For present purposes we can simply say the following: a line is complex to the extent that its stressed syllables fail to occupy *s* position and its *s* positions fail to be occupied by stressed syllables. Later on I will discuss other 'complexity rules' in Shakespeare, which motivate the hierarchical structure of Figure 1.

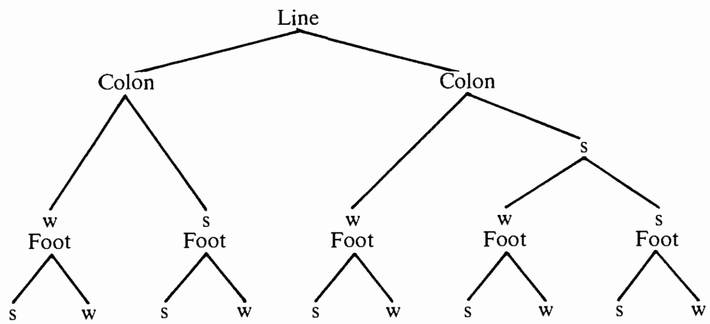


Figure 2. Rhythmic pattern for the Serbo-Croatian epic decasyllable

II. *The Serbo-Croatian epic decasyllable*. This meter was used in oral poetry: the epic verse composed spontaneously by Serbian *guslars*. The following account is based on work of Jakobson (1933, 1952).

The metrical pattern for this verse is hierarchical in nature. Each line consists of five trochaic feet, grouped into cola containing two and three feet respectively (see Figure 2). Observe that this pattern is quite similar to the one used by Shakespeare. However, as the correspondence rules involved are completely different, the outward form of the verse differs drastically from English. In particular, stress plays only a minor role, and the major constraints are placed on word boundary location and syllable quantity.

(8) *Rules governing word boundary placement*
  a. A phonological word boundary occurs obligatorily at the end of each colon.
  b. Colon-final feet may not include a word boundary.

(9) *Rules governing syllable quantity*
  a. If the ninth position is filled by an accented syllable, that syllable must be heavy.
  b. If the seventh or eighth position is filled by an accented syllable, that syllable must be light.[2]

Examples of lines observing the above rules are as follows. [/] indicates colon boundary, length is indicated by [:], and other diacritics denote various tonal accents.

(10)	Stȅva:n ùsta / iz šàtora svôga	Stevan rose from his tent,
	Pa pȉrfati: / žȉcu telefó:na	gripped the telephone wire;

[2] According to Jakobson, all nonfinal syllables are open, at least in the style of speech used for verse recitation. Hence 'heavy syllable' here is equivalent to 'long-voweled syllable.'

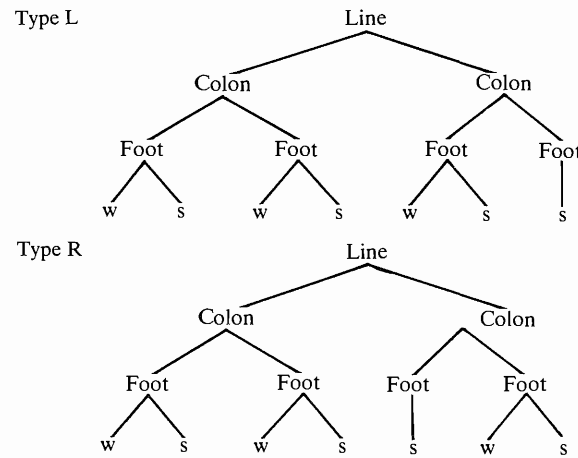


Figure 3. Rhythmic patterns for Chinese regulated verse

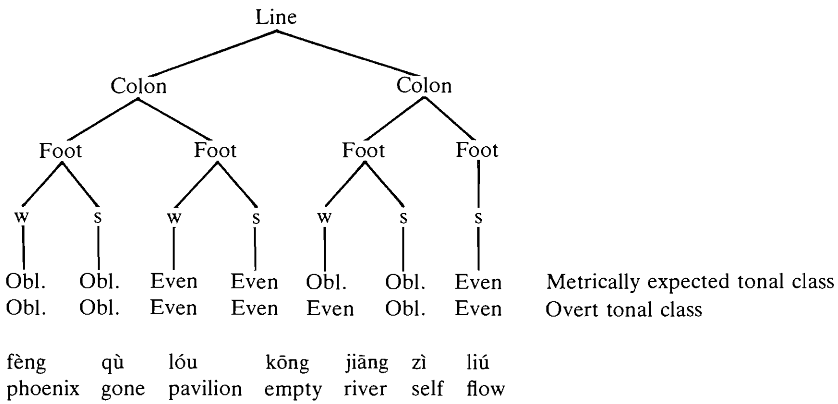
Vî:če Stȅva:n / svòje brigadí:re	Stevan called his brigadiers
I nàniže / dȍle oficí:re	and his junior officers.

(guslar Radovan Ilić, heroic song on the battle of Dobrudža (1916))

The rules of (8)–(9) are iron-clad rules governing metricality. In addition, Jakobson noted the following rules governing complexity. (a) Stress tends to fall in metrically strong positions. (b) Syntactic breaks tend to coincide with line boundaries; failing that, they normally coincide with colon boundaries; failing that, they virtually always coincide with foot boundaries. (c) The quantitative restrictions of (9) are adhered to in unaccented syllables, though not as strictly as in accented syllables.

III. *Chinese regulated verse* (Chen 1979, 1980; Yip 1980, 1984). Here, there are two basic metrical patterns, which always co-occur in a quatrain (see Figure 3). The second colon is left-branching in Type L, right-branching in Type R. The patterns are deployed by the following principles. First, a quatrain consists of two couplets, one containing Type L lines, the other containing Type R lines. Each foot of each line is assigned to one of two tonal classes, comprising the 'even' tones and the 'oblique' tones, following a scheme outlined in Chen (1979). The rather complex pattern that results is overtly realized by a simple correspondence rule: the strongest syllable of a foot must bear a tone belonging to the tonal class of its foot. Figure 4 contains an example of a line that obeys this rule.

There are also rules governing complexity. First, the weak syllable of a foot, as well as the strong one, ordinarily bears a tone appropriate to the tonal class of the foot. This happens, for example, in two of the three disyllabic feet in Figure 4. Second, the phrasal structure of a line is ordinarily isomorphic to



'The phoenix is gone, the pavilion is empty; the river flows on'

Figure 4. A scanned line of Chinese regulated verse

the line's metrical structure. In fact, severe violations of the latter rule, with extreme disagreement of phrasing and meter, are close to unmetrical. The only mismatch in Figure 4 occurs in the second colon, where *zì líu* 'self flow' is a mismatched phrase.

The three examples I have just presented only hint at the great variety found in the metrical systems of the world. In particular, the richness of phenomena found in prosodic phonology is matched by a parallel richness in how prosodic elements are deployed in meter. Only recently has it become possible to consider seriously what general principles might underlie the world's metrical systems. The possibility of truly explanatory work arises both from greater descriptive knowledge of metrical rules, and from recent advances in phonological theory which have proven directly applicable to metrics. In what follows, I will describe some areas in which metrics and phonology have aided each other's progress, and suggest glimpses of where a theory of universal metrics might ultimately lie.

12.2. Phonemic representation

A good place to start is with a basic assumption of phonology: that in the phonological system speech sounds are fundamentally *categories*, specified as distinct from each other, but lacking in quantitative detail until the very end of a derivation. This assumption is crucial to all theoretical work in phonology. As Jakobson (1933) pointed out, the evidence of metrics confirms it empirically. In all languages, metrical rules refer to phonological categories rather than to their overt physical manifestations.

Here is one of Jakobson's examples. In all languages, syllables vary in

their phonetic length, as determined by segmental and other influences. It is easy to imagine a meter based on phonetic syllable duration, in which syllables would gravitate statistically towards long or short metrical positions depending on their phonetic length. But no such meter exists; instead, we find numerous 'durational' meters that rely on a *categorical* opposition. In these real-life quantitative meters, the language in question has a phonemic vowel length contrast, which forms the basis of a distinction between heavy and light syllables (see below), which in turn are matched against long and short metrical positions.

Jakobson's (1933) claims go beyond just limiting metrical relevance to phonological categories; he further suggested that only those categorical distinctions that are *phonemic in the language in question* may play a role in the metrics of that language. Taken in the strictest sense, this cannot be true, as stress is involved in the metrics of several languages that have predictable stress, such as Latin and French. But as a tendency it is undeniable, and helps account for why the metrics of a language is determined to a large extent by its phonology.

Kiparsky (1973) offers a variant on Jakobson's theme: if we think of a meter as a rhythmic repetition of linguistic sames, we can ask what subset of logically possible 'sames' can actually count as the same for metrical purposes. Kiparsky's answer is that the linguistic sames of verse are to be identified with the linguistic sames provided under universal grammar. For example, universal grammar permits phonological rules that count the number of syllables in a word, but apparently not rules that count the number of segments. The same holds true for rules of metrics. Similarly, the schemata that govern possible reduplication rules in phonology appear to be the same as the schemata that determine possible alliteration rules in metrics. If Kiparsky's thesis is right, then metrics can provide additional tests for proposals concerning the universally determined limits of linguistic competence.

12.3. Phonological derivations

The research program of generative phonology in the 1950s and 1960s was in part dedicated to showing that words are often phonemically represented in a highly abstract form, far removed from the phonetic surface. In large part, the evidence for this was that abstract representations permitted accounts of complex surface patterns using a small number of rules. However, phonologists also sought 'external evidence' (cf. Kenstowicz & Kisseberth 1979: ch. 5) to corroborate the conclusions arrived at with purely linguistic data. Data from metrical systems have played an important role here. The crucial cases have been those in which phonological material must be scanned, not according to its surface form, but according to its abstract underlying representation.

Consider a simple case from English. It can be argued that the final phonetic [m̩] in words like *spasm*, *orgasm*, and *syllogism* is underlyingly nonsyllabic /m/, and is vocalized on the surface due to the following rule:

(11) m → [+syllabic]/C—#

The arguments are as follows. (1) The nonsyllabic /m/ always shows up before vowel-initial suffixes (*spasmodic*, *orgasmic*, etc.). (2) *sm#* words are surface exceptions to a general rule (see Schane 1972 and later work) requiring that the rightmost nonfinal stressed syllable of a stem bear the main stress; compare exceptional *enthúsiàsm* with regular *enthùsiástic*. If /m/ is nonsyllabic at the time this rule applies, then *enthúsiàsm* will receive the correct stress contour in the same way as words like *enthúsiàst*. (3) *sm#* words always violate a general rule of Post-Stress Destressing (Chomsky & Halle 1968; Hayes 1982), which removes weak stress from nonfinal syllables when it immediately follows strong stress, as in *sénsory* from /sénsòry/ (cf. *aúditòry*). This rule never applies in words like *báptìsm*, *phántàsm*, *sárcàsm*, suggesting again that vocalization of /m/ is a late process.

On these grounds, then, it is arguable that word-final postconsonantal [m̩] in English is underlyingly nonsyllabic. It is thus interesting to note (Kiparsky 1975) that most English poets treat final [zm] as if it did not form a syllable:

(12) a. In the dark backward and *abysm* of time?
w s w s w s w s Ø w s (Shakes., Tmp. 1.2.50)
Where it draws blood, no *cataplasm* so rare (Ham. 4.7.143)
b. To all Baptíz'd: to his great *Baptism* flock'd
(Milton, *Paradise Regained* 1.21)
Their *Idolisms*, Traditions, Paradoxes? (PR 4.234)
c. Or under *chasms* unfathomable ever (Shelley, Witch of Atlas 42.3)
Whose shrieks and *spasms* and tears they may enjoy? (Hellas 243)
d. To bury in its *chasm* a crime like this (Longfellow, Torquemada)

This is a straightforward example of what has been widely observed in other metrical systems: that the phonological representation scanned is one in which some or all of the phonological rules are 'undone.' Parallel examples have been found in Latvian (Zeps 1963, 1969, 1973), Old Norse (Anderson 1973), Turkish (Malone 1982), Vedic Sanskrit (Kiparsky 1972; see also Hock 1980), Old Irish (Malone 1984), Sephardic Hebrew (Malone 1983), and Finnish (Kiparsky 1968). The last of these is perhaps the most remarkable; Kiparsky shows that the Finnish national epic, the *Kalevala*, is written in a meter which requires that the phonology be 'undone' down to an astonishing

depth. He further argues that this cannot be due to mere convention, that is, to an artificial invocation by poets of the historical scansions of the relevant words.

12.4. Hierarchical structure in phonology

The last decade has seen a thorough rethinking of what phonological representations look like. The theory proposed in *The sound pattern of English* (Chomsky & Halle 1968) invoked an extremely impoverished form of representation, consisting of linear strings of segments and boundaries, represented as feature bundles. The formal simplicity of this system was in itself a virtue, but ultimately proved a handicap to the understanding of complex phonological phenomena. The drastic enrichments proposed over the last ten years to correct this have gone in two directions.

In *autosegmental* theory, the phonological features are split up into parallel tiers. The tiers form quasi-independent sequences, each responsible for only a subset of the phonetic properties of an utterance. The segments of each tier are aligned in time using association lines, which denote simultaneity.

The other main strand of research is called (unfortunately for our purposes) *Metrical* theory. As the potential for confusion is large, I will distinguish phonological Metrical theory from the theory of poetic metrics by capitalizing the former. Metrical theory in phonology is concerned with phonological hierarchies; that is, with the organization of segments into syllables, syllables into feet, and so on into higher-level structure.

It can be argued that the empirical domains of autosegmental and Metrical theories are largely disjoint (cf. Anderson 1982). Autosegmentalism treats the disposition of phonetic properties in time, in areas like tone, nasal spreading, vowel harmony, contour segments, and the like. In Metrical theory, the phonetic properties of segments are largely irrelevant; we are concerned instead with the hierarchical relations of segments to each other. These involve syllable structure, phrasing, and stress. The latter is viewed in Metrical theory as embodying the rhythmic structure of a phonological representation.[3]

The way in which rules of metrics refer to the subdomains of phonology is partly predictable. Metrical rules may be divided into two distinct categories, which I will call *correspondence rules* and *identity rules*. All the rules discussed so far are correspondence rules: they determine when linguistic material is properly aligned with an abstract metrical template. Identity rules require that one part of the linguistic representation of a poem be identical or

[3] See, however, Halle & Vergnaud (1987), who argue that stress embodies both Metrical and autosegmental aspects.

similar to another part; these include rules for rhyme, assonance, alliteration, and the like.

It appears that correspondence rules refer only to Metrical representations; that is, they ignore the phonetic content of segments and are concerned only with their hierarchical relationships. Thus, while it is easy to imagine a meter which requires that syllables alternatingly contain front and back vowels, no such meter appears to exist. A survey of the basic verse types confirms the Metrical basis for correspondence rules. In quantitative meters, the phonologically relevant distinction is between heavy and light syllables, clearly an aspect of syllable structure (see below). Stressed-based verse, as in English, refers to the Metrical stress representation of an utterance. Verse based on boundary placement (e.g. the Serbo-Croatian meter noted above) appears also to refer to a Metrical hierarchy, as I will argue below.

The only possible recalcitrant case here involves tonal verse, as in Chinese. Although tones are in a sense 'prosodic,' they clearly embody specific phonetic substance. However, the rules for Chinese verse proposed by Chen (1979) show that the tonal patterns are largely disposed so as to meet an identity requirement, that of rhyme, rather than a correspondence requirement. Further, Yip (1984) argues that the tones were historically superimposed on an earlier nontonal metrical system that was extremely similar to the later tonal verse in all other respects.

For the sake of parallelism it would be nice to be able to say that the second class of metrical rules, those enforcing identity, refer only to autosegmental representations. Too little is known here, however, about either the metrical facts or the relevant aspects of autosegmental theory. We must clearly allow Metrical phonology to determine the phonological locations subject to identity requirements, as the syllables that rhyme and alliterate are usually stressed syllables.

With this general background, I will now consider three areas of Metrical phonology and their interrelation with metrics.

12.4.1. Syllable structure

Research on hierarchical syllable structure has centered on a number of areas; of these, the most significant for metrics has been the theory of 'syllable weight.'

Syllable weight plays a role in many phonological rules, but is most directly relevant to stress placement. Typological study of the world's stress rules shows that they normally refer only to a small fraction of the information available in the phonological string. In particular, stress rules either simply count syllables (for example, in assigning stress to the penultimate syllable), or they make a distinction of syllable weight, dividing the syllables

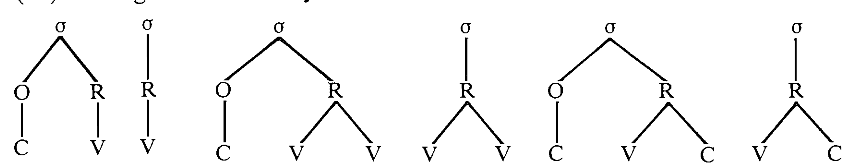
of a language into heavy and light classes. The stress rule of Latin is a canonical example of this type; it assigns stress to the penult if it is 'heavy;' otherwise to the antepenult. (If a word lacks sufficient syllables to conform to this rule, stress is placed as far as possible to the left.) In the data of (13), I represent length as gemination.

(13) a. *Light syllables in Latin*: V, CV, CCV
cf. áe.*o*.lus, com.pó.*ne*.re, mé.*tri*.cus, with antepenultimate stress
b. *Heavy syllables in Latin*: VV, CVV, CCVV; VC, CVC, CCVC
cf. hi.*áa*.tus, re.*fée*.cit, re.*plée*.tus
co.*ác*.too, con.*tín*.git, re.*prés*.see, with penultimate stress

Comparison of (13a) and (13b) demonstrates an interesting fact: adding consonants to the end of a syllable (or lengthening the vowel) adds to its weight, whereas adding consonants to the beginning of a syllable does not. This is a general observation, which holds for numerous languages not related to Latin.

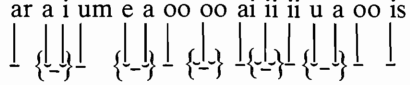
There are a number of ways to account for this formally. To my mind the most convincing is a proposal of McCarthy (1979) that the syllable universally consists of two primary constituents which, following earlier work, he calls the *Onset* and the *Rhyme*. The Rhyme contains the vowel plus any following consonants, and constitutes the 'prosodically active' portion of the syllable. The Onset contains all prevocalic consonants, and is prosodically inert. As the representations below show, a heavy syllable in the traditional sense can be characterized as having a branching Rhyme.

(14) a. Light b. Heavy



Numerous stress rules refer to the distinction between branching and nonbranching Rhymes; see Hayes (1980) for a survey. The Rhyme constituent also allows for coherent expression of a number of phonological universals. For example, in many languages vowel length is in a trading relationship with the number of consonants following the vowel within the syllable; if short vowels can be followed by *n* consonants, then long vowels may only be followed by *n−1*. Such trading relationships never occur between vowel length and the syllable-initial cluster. The generalization is that languages typically impose a maximum on the length of the Rhyme, not on the syllable as a whole.

The evidence from metrics strongly supports the existence of the Rhyme: to my knowledge, all metrical systems that employ an opposition between long and short syllables use the distinction between branching and nonbranching Rhymes; i.e. the traditional heavy–light distinction. I illustrate this with a scansion of the first line of Virgil's *Aeneid*, written in the Latin quantitative dactylic hexameter. /–/ and /⌣/ represent long and short metrical positions, respectively.

(15) Arma virumque canō Trōiae quī prīmus ab ōris
ar ma wi rum k^we ka noo troo yai k^wii prii mu sa boo ris (syllables)
ar a i um e a oo oo ai ii ii u a oo is (Rhymes)

(meter)

The range of quantitative metrics is impressive. Languages which have at least partly quantitative meter, and which use the branching vs. nonbranching Rhyme distinction, include Latin, Greek, Sanskrit, Hindi, Arabic, Hausa, Persian, Old Norse, Finnish, Hungarian, Malayalam, and Serbo-Croatian. Kiparsky (forthcoming) argues that the badly misunderstood 'sprung rhythm' meter of Gerard Manley Hopkins is based in part on quantity. The quantitative system Hopkins uses invokes the characteristic embellishments English phonology adds to the basic heavy–light distinction (Hayes 1982).

Metrics can provide evidence to decide between rival hypotheses concerning how quantity is best represented in syllable structure. Clements & Keyser (1983) have suggested that the Rhyme constituent can be dispensed with, to be replaced by a Nucleus. The Nucleus would consist of the first two segments of what is included in the Rhyme, but no more. Since quantity distinctions are usually binary, this more limited structure provides the same quantity distinctions as that described by the branching/nonbranching Rhyme distinction.

Stress rules provide little evidence to indicate which theory is correct. However, the quantitative meter of Persian (Elwell-Sutton 1976; Hayes 1979; Heny 1981) is more illuminating. In Persian metrics, syllables are classified into three quantities, as follows:

(16)

Type	*Membership*	*Scansion in meter*
Short	CV, V	⌣
Long	CVC, VC, CVV, VV	– or ⌣⌣
Overlong	CVCC, VCC, CVVC, VVC	–⌣

The generalization underlying the system should be apparent: every segment in a Rhyme corresponds either to a single short metrical position or to half of a long one. Thus in an overlong syllable, even the final consonant is prosodically active.

The latter fact provides some support for the proposal of a Rhyme constituent. The Nucleus theory would incorrectly assign the prosodically active second consonant of an overlong syllable the same status as a prosodically inert syllable-initial consonant, as (17) shows.

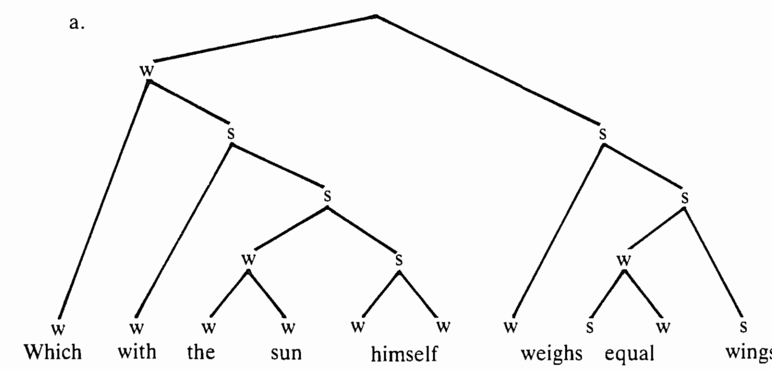
(17)

	Short	*Long*	*Overlong*
Number of segments in Rhyme:	1	2	3
Number of segments in Nucleus:	1	2	2

In other words, the Nucleus theory wrongly predicts that adding a consonant to the right of the Nucleus should have effects no different from adding a consonant to the left. In so far as the two pattern differently, we have an argument to favor the Rhyme theory of syllable constituency.

12.4.2. Metrical stress theory

Under the Metrical theory of stress (Liberman & Prince 1977; Selkirk 1980a; Hayes 1980; Prince 1983), stress is regarded as the rhythmic structure of an utterance, embodying *relative* contrasts of prominence, rather than a local phonetic property of vowels. In particular, stress is not viewed as an *n*-valued distinctive feature, as was proposed in *SPE*. Figure 5 depicts both the Metrical and the linear stress representations for a line of verse. The *w*'s and *s*'s are to be interpreted as a relation of relative w(eakness) to s(trength), defined on sister nodes.

a.


	–	–	–	3	– 2	3	4 –	1	(value of fea[ture]
b.	Which	with	the	sun	himself	weighs	equal	wings	[stress])

(Crashaw, *Sospetto d'Herode* 2

Figure 5. Metrical vs. linear representations for stress

Work in metrics, notably Kiparsky (1977), strongly supports the Metrical theory. In particular, while metrical rules very frequently refer to the *relative* strength of neighboring syllables, they never refer crucially to a particular numerical level of stress, as the *SPE* theory would predict. Kiparsky demonstrates that his earlier work on metrics (1975) was seriously hampered precisely because of its use of *SPE*-style stress representations rather than Metrical theory.

While the notion of Metrical stress theory seems well-motivated in general, there remains considerable debate over the specifics of the theory and how to express them formally. Hayes (1983) argues that empirical improvements over Kiparsky's results can be obtained if the metrical rules refer not directly to trees, but to the Metrical 'grid' representations which Liberman & Prince (1977) originally proposed as a means of interpreting trees. At the same time, it was proposed in purely phonological work (Prince 1983; Selkirk 1984) to dismiss trees altogether, using grids as the sole means of representing stress. In my view, the most promising kind of representation would be a hybrid combining both tree and grid information (see Hammond 1984; Halle & Vergnaud 1987 for specific proposals). However, the issue remains open.

Metrical evidence can help to resolve this question, as the writing of metrical rules requires a precise and explicit characterization of the 'levels of stress' available in a language (Hayes 1983; Schlerman 1984). In addition, it is possible to outline some more general aspects of a Metrical stress theory that are demanded by the metrical data.

Phrasal stress rules appear to fall into two major types. One assigns a binary prominence relation between sister constituents. For English, such rules include the Nuclear Stress Rule, which labels phrasal constituents as *ws* (cf. *èqual wíngs* in Figure 5). The other kind of rule assigns greater prominence to individual elements, simply by virtue of their inherent prosodic status. For example, if one compares *in the trées* with *in tall trées*, it is clear that *tall* bears greater stress than *the*. This is predictable; it follows from the fact that *tall* is a lexical category, whereas *the* is a phonological clitic. Hayes (1983) and Schlerman (1984) argue that this second class of rules, which is most easily stated in grid notation, is crucial in metrics.

There is a third, minor class of stress rules, which are generally optional and variable in their application. Such rules assign prominence relations to pairs of syllables that are not assigned a prominence relation by the first two classes of rules. Thus in *weighs equal wings* (Figure 5) the stresses on *weighs* and *equal* are not assigned a prominence contour by the Nuclear Stress Rule, as they are not sisters. The rule that promotes the stress on lexical categories applies to both words; thus there is no firm prominence relation between the two. Accordingly, it is possible to assign greater stress to either one, as in

wèighs equal wíngs or *weighs èqual wíngs*. (See Hayes 1984a; Selkirk 1984; Giegerich 1985 for accounts of the relevant rule.) Not surprisingly, it is this third class of prominence relations that are least relevant to meter; they scan much more freely than other sequences.

The upshot of this discussion is as follows. Rather than providing a single, unitary numerical stress contour to phrases, as the *SPE* system does, Metrical theory factors phrasal stress assignment into several distinct rules. This factoring out is empirically confirmed by the varying amounts of influence each rule has on scansion. While this generalization cannot decide between most current competing versions of Metrical theory, it does argue that the Metrical approach constitutes progress over earlier models.

12.4.3. Phonological phrasing: the *prosodic hierarchy*

Another use of Metrical structure in phonology has involved specifying *rule domains*. Many phonological rules apply across word boundaries; of these, a large fraction are constrained to apply only within certain phrasal domains. For example, the English Rhythm Rule (the rule that derives *thìrteen mén* from *thirtèen mén*) generally applies only when the secondary stress that is shifted leftward and the primary stress that induces the shift both occur within the same close-knit phrasal unit. Thus, while the stress on *Mississíppi* readily shifts leftward in *Mìssissippi múd*, it cannot shift in **The governor of Mìssissippi vétoed it*.

Let us refer to the set of phrasal sequences within which a rule R may apply as the *bounding domain* for R. One may then ask what the basis of bounding domains is across languages. The obvious answer, of course, is that bounding domains are syntactic constituents. But in the languages that have been carefully studied, this turns out to be incorrect – cf. Clements (1978), Nespor & Vogel (1982), Odden (1984), McHugh (1987), and other work.

The most adequate theory of bounding domains, in my opinion, is that proposed in recent work by Selkirk (1978, 1980b, 1981) and Nespor & Vogel (1982). Under this theory, phrasal phonology is governed by an independent constituent structure, called the *prosodic hierarchy*, which is derived by rule from syntactic structure but is not identical to it. The rules that derive the prosodic hierarchy vary across languages, though the variation appears to fall within universally determined limits; see Hayes (forthcoming) for a survey.

The most salient aspect of the prosodic hierarchy is that it is *strictly layered*. This means that the topmost labeled constituents have as their daughters only constituents of the second highest type; which have as their daughters only constituents of the third highest type; and so on, down to individual words. Strict layering clearly cannot be a property of syntactic structure, which is normally self-embedded. To give an example, the syntac-

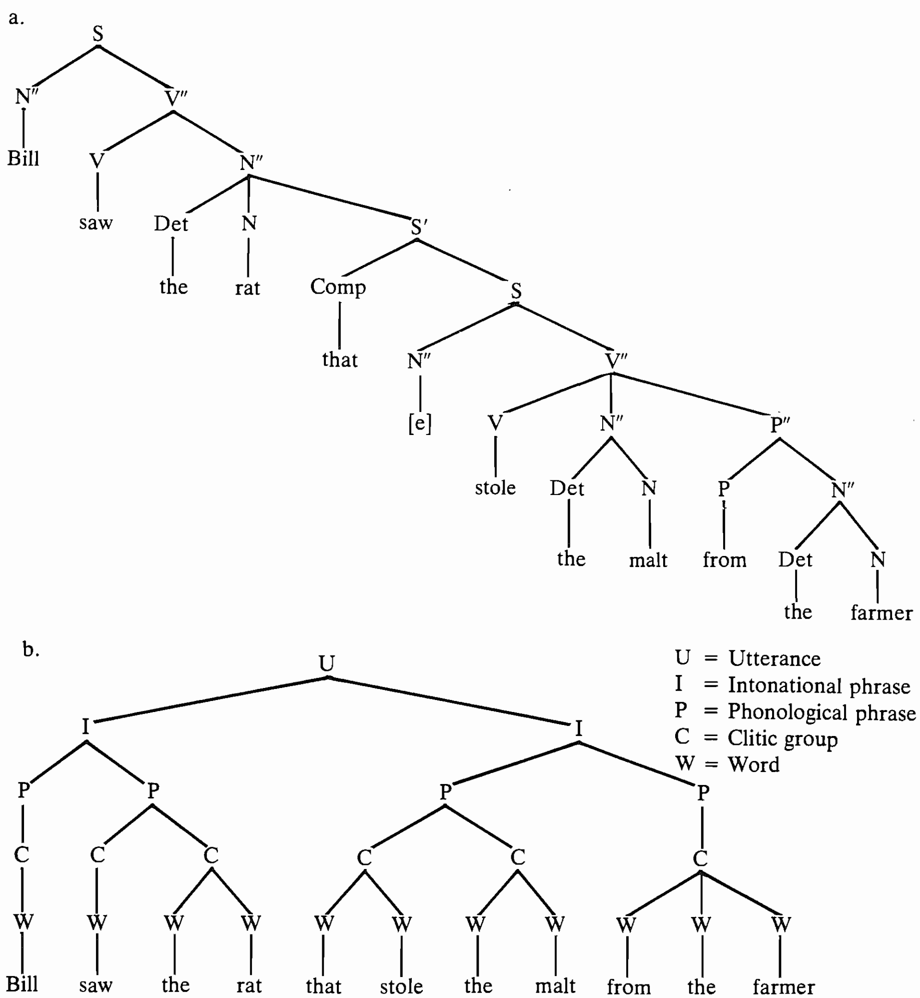


Figure 6. The syntactic structure and prosodic hierarchy of a sentence

tic structure depicted schematically in Figure 6a can be argued to give rise to the prosodic hierarchy of Figure 6b.

The strongest evidence for strict layering concerns the relationship among phonological rules of the same language: if rule A refers to one bounding domain and rule B to another, then the two domains never overlap; one domain must form subconstituents of the other. If the only possible bounding domains of rules are categories in a strictly layered hierarchy, this is what we predict.

In addition, sometimes several rules of the same language make reference

to the same rather idiosyncratic phrasal domain. If the domain is defined by the rules constructing the prosodic hierarchy, then we can capture the generalization in a single statement, rather than repeating the idiosyncratic domain in the structural description of every rule that refers to it.

Phonological rules make reference to the prosodic hierarchy in two ways. Most typically, a category of the hierarchy serves as the bounding domain of a rule. Thus the Rhythm Rule normally applies only if the focus and trigger lie within the same *phonological phrase*, as defined in the rules proposed by Nespor & Vogel (1982). In addition, phonological rules sometimes refer directly to the edges of a domain. Thus in Chi-Mwi:ni (Kisseberth & Abasheikh 1974; Hayes forthcoming), there is a rule that specifies the rightmost vowel in every phonological phrase as short.

The evidence gathered so far from metrics (cf. Dillon 1977; Devine & Stephens 1984; Hayes forthcoming) supports the prosodic hierarchy theory. Metrical rules are highly sensitive to the phrasings of the hierarchy, and they seem to refer to the hierarchy in just the same ways as phonological rules: they can be bounded within a particular domain, or can refer to particular phrase edges.

The 'Monosyllable Rule' for Shakespeare described above in (5) is a simple example of a bounded rule in metrics. If we refer to the prosodic hierarchy, the rule may be expressed in a very simple way: we require that any rising or falling stress contour on adjacent syllables must match the meter perfectly, with the proviso that the rule is word bounded. The rule thus can only 'see' stress sequences that occur within polysyllabic words. This is illustrated by the following scansions.

(18) a. *Obeys the Monosyllable Rule*
Plúck the kéen téeth from the fíerce tíger's jáws.
w s w s w sw sw s
(Shakespeare, Son. 19)
Sequences where the Monosyllable Rule can apply:
[tíger's]
s w

b. *Violates the Monosyllable Rule*
*Plúck imménse téeth from enráged tígers' jáws. (Kiparsky 1975)
w s w s w s w sw s
Sequences where the Monosyllable Rule can apply:
*[imménse], *[enráged], [tígers']
s w s w s w

A remarkable consequence of this rule, discovered by Magnuson & Ryder (1970), is the counterintuitive scansion it requires for compounds that have the stress pattern *x́–x̀ x*, as in *grándfàther*, *lóve-làcking*. Because the

Monosyllable Rule only 'sees' one half of the compound at a time, and the monosyllabic first member will be properly scanned in any event, Shakespeare places these compounds in metrical *wsw* position, thus making their strongest stress metrically weak:

(19) a. How much *sált wàter* thrown away in waste (Rom. 2.3.71)
w s w sw s w s w s
b. As this *fóre-spùrrer* comes before his lord (MV 2.9.95)
c. And looking on it with *láck-lùstre* eye (AYL 2.7.21)

The word is a salient unit on the prosodic hierarchy, governing numerous phonological rules. Not surprisingly, versions of the Monosyllable Rule are widespread in metrics, governing the verse of many English poets, as well as most of Russian (Žirmunskij 1966), German (Bjorklund 1978), and Dutch (Koster 1983) verse.

As mentioned earlier, metrical rules, like phonological rules, often refer to the edges of units on the prosodic hierarchy. A typical pattern here is that rules requiring especially strict correspondence of meter and line apply at the right edges of units, while rules assigning extra freedom of scansion apply at the left edges. Here is an example: in Milton, the right edges of high-ranking phrases normally do not contain rising disyllabic stress contours that go against the meter (Buss 1974; Kiparsky 1977). The rarity of such cases depends on the rank of the phrase in question on the prosodic hierarchy. Thus if the phrase is a phonological phrase, exceptions are moderately rare; they occur in only 64 of the 12,500 lines in *Paradise Lost* and *Paradise Regained*. If the phrase ranks higher, as an intonational phrase, the exceptions are much rarer; there are only eight examples. If the phrase is a full utterance, the constraint becomes categorical, and no examples at all occur.

(20) a. *Mismatched rising sequences, right edge of phonological phrase (64 lines)*
To *gìve Líght* on the Earth; and it was so (*Paradise Lost* 7.345)
w s w s w s w s w s
The *fùll bláze* of thy beams, and through a cloud (PL 3.378)
w s w s w s w s w s

b. *Mismatched rising sequences, right edge of intonational phrase (8 lines)*
Round he surveys, and *wèll míght*, where he stood (PL 3.555)
s w s w s w s w s w
Behold mee then, mee *for hím*, life for life (PL 3.236)
w s w s w s w s w s

c. *Mismatched rising sequences, right edge of utterance (no examples)*
*To *gìve líght*. And God saw that it was good (construct)
w s w s w s w s w s

As can be seen, the frequency of lines diminishes as the rank of the relevant category rises. This is what we would logically expect in a strictly layered hierarchy: every right edge of a high-ranking category is necessarily the right edge of all lower-ranking categories at the same time.[4]

At left edges, the opposite pattern holds: the higher the category, the more freedom is provided for 'inversions' and the like; see Hayes (1983, forthcoming) for examples. In general, the ways in which metrical rules refer to the hierarchy appear to validate a general principle suggested by Kiparsky (1968): metrically speaking, beginnings tend to be free, endings strict.

The theory of the prosodic hierarchy is still in a very tentative state; much research will be needed to verify and improve it. I foresee that the evidence from metrics will be very useful in this task. At least for English, it seems that the evidence from metrics is clearer and easier to interpret than the available phonological evidence.

12.5. Rhythmic hierarchies

Kiparsky (1977) suggested that the kind of hierarchical structure posited in Metrical phonology might be suitable for describing the underlying patterns of meters. Subsequent research has supported this proposal. In particular, both the prominence relations (the sw labeling) and the bracketing structure of Metrical trees are empirically validated by their phonological correlates in verse. To see this, consider the metrical pattern for Longfellow's *Song of Hiawatha*, as I have analyzed it in Hayes (forthcoming) (see Figure 7). The pattern is a trochaic tetrameter: the four feet are grouped into two cola labeled *ws*, with the line as a whole labeled *ws* as well.

Evidence for the pattern comes from a number of sources. First, word boundaries coincide with foot boundaries with greater than chance frequency; that is, they tend to fall before strong positions, whereas in Longfellow's iambic verse they fall more often before weak positions. Second, the predominant syntactic pattern of a line matches the colon bracketing; one finds many lines like *Hiawatha! Hiawatha!* but few lines like *Never, Hiawatha, never!* The third kind of evidence is obtained from the

[4] I have oversimplified the argument somewhat, since to make a true comparison one must control for the overall frequencies of phonological phrase, intonational phrase, and utterance breaks within lines. With this taken into account, one still finds large frequency differences. For example, mismatched phonological phrase endings are about four times as common relative to their overall frequency as mismatched intonational phrase endings; the difference is statistically significant.

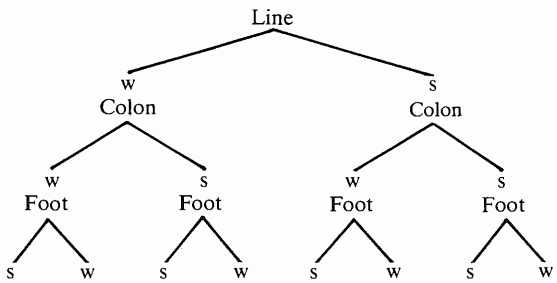


Figure 7. The meter of *Hiawatha*

methods of the Russian school of metrics (Bailey 1975; Tarlinskaja 1976; Smith 1980). These metrists often compile 'stress profiles,' which measure the frequency with which each position in a line is filled by a stress. A stress profile for *Hiawatha* roughly matches the abstract stress contour of Figure 7 if the pattern is interpreted by the normal conventions for Metrical trees.

(21) *Stress profile for* Hiawatha, *Book XIII (235 lines)*

Position:	1	2	3	4	5	6	7	8
% Stressed:	53.2	1.7	85.5	5.5	68.5	0.4	100	0.9

Observe that the seventh, strongest position of the meter is obligatorily filled with stress, a generalization which holds true for the entire poem.

The existence of hierarchical grouping has long been debated in the metrical literature, particularly in regard to whether feet exist. It is agreed that the foot is sensible as a purely theoretical notion, in that it expresses the inherent periodicity of verse. As Chatman (1965:116) says, 'It is simpler to assume that the series ⏑–⏑–⏑–⏑–⏑– consists of five recurrences of one event, ⏑–, than that it constitutes some single homogeneous event.' However, numerous metrists (including Chatman) have denied the significance of this, claiming that there is no evidence for feet in the verse itself (see also Jespersen 1933; Bailey 1975; Attridge 1982).

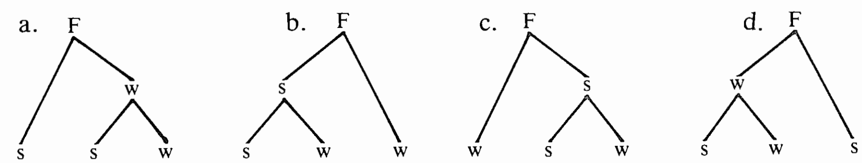
This widespread disbelief in hierarchical grouping stems in part from a too narrow database. It is true that many English poets, for example Shakespeare, show no tendency to place word boundaries in positions coinciding with foot boundaries. But nothing says that poets *have* to make the two line up; indeed, critics intuit such a lineup to be banal. The real point is that it would be difficult to explain the word boundary placement of other poets (like Longfellow) *without* positing feet. (See Jakobson 1974:120–2 for a similar contrast in Czech verse.) In addition, opponents of the foot have not taken into account various other kinds of more subtle evidence for bracketing; cf. the arguments for feet in Kiparsky (1977), Youmans (forthcoming),

and Tarlinskaja (1984). Finally, and most important, there exist metrical traditions (e.g. Finnish, Serbo-Croatian, Latvian) where coincidence of word and foot boundaries is an essential ingredient of metrical well-formedness. These cases strongly validate the foot (and hierarchical structure in general) as a theoretical concept.

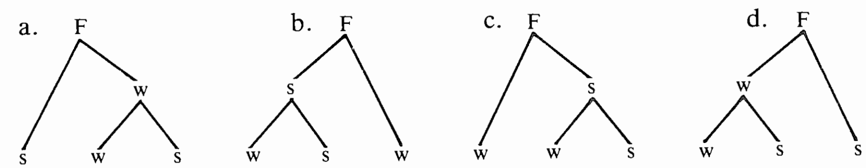
Some of the most interesting recent work in metrics has striven for a general theory of hierarchical metrical patterns; cf. the work of Kiparsky (1977), Piera (1980), Stein & Gil (1980), and Prince (forthcoming). I will review two specific proposals here.

Kiparsky (1977) and Prince (forthcoming) argue that the inventory of possible foot structures is limited by the following constraint: any branching node that is internal to a foot (Prince's 'subdivided metrical position') must be labeled *sw*. If we assume binary branching, this constraint limits the inventory of ternary feet to the configurations of (22), and excludes the logically possible structures of (23).

(22) *Possible ternary feet*



(23) *Impossible ternary feet*



To the extent that the foot trees are empirically distinguishable, it appears that all and only those feet meeting the sw constraint are used in actual meters. For example, all known anapestic verse observes the pattern of (22d), which contains a secondary strong position foot initially, thus allowing lines like (24a). No anapestic verse gives the foot-medial position secondary prominence, as would be required by (23d), or makes both the first and second positions weak, as (23c) would require. The lines of (24b,c) illustrate what verse in these nonexistent meters would sound like.

(24) *Anapestic meters*

a. Possible: (22d)

I have known *nòble héarts* and great souls in thy sons

(Byron, *The Irish Avatar* 110)

b. Impossible: (23d)
*I have known *devòut héarts* and great souls in thy sons (construct)

c. Impossible: (23c)
(24a) is ill-formed, and would have to be replaced by
I have known *of the héarts* and great souls in thy sons (construct)

Prince (forthcoming) also applies the *sw* law to a completely different area, the quantitative meters of Classical Arabic. The analysis he proposes is remarkable in its abstractness and in the hidden connections it reveals in the system.

Piera (1980) has made an important proposal for characterizing the inventory of possible metrical patterns. He argues that all meters must meet a requirement of symmetry called *Even Distribution*. This can be defined briefly as follows. Let the *cardinality* of a metrical constituent be the maximum path length from its root to a terminal node. For example, the cardinality of the ternary feet of (22)–(23) is three, and the cardinality of iambic pentameter (Figure 1) is five. Piera's constraint can be stated as follows:

(25) *Even Distribution*
The cardinality of sister nodes in a metrical pattern must:
a. differ by at most one (marked case);
b. be equal (unmarked case).

Even Distribution makes numerous predictions. First, all tetrameters should be symmetrical, as the logically possible asymmetrical arrangements of four feet violate Even Distribution even in the marked case. This is illustrated in Figure 8. I have labeled nodes with their cardinality, ignoring foot-internal structure. The remaining possibilities are the mirror images of b and c in Figure 8, and are also excluded.

The facts confirm this prediction of symmetry. Thus Persian tetrameters, but not trimeters, may have a midline caesura. The usual phrasing of the line

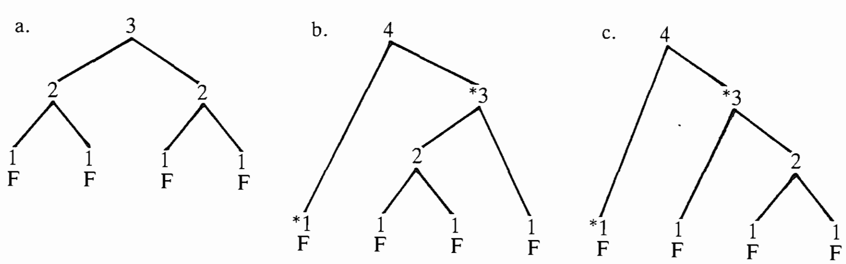


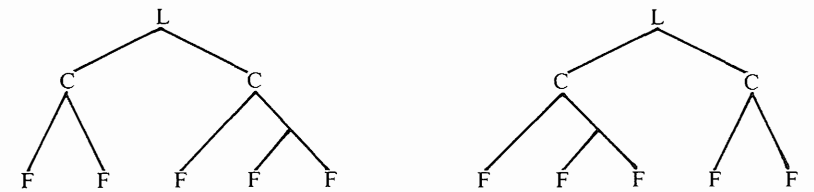
Figure 8. Even distribution in tetrameters

reinforces the symmetrical 2+2 scheme for tetrameters in English, Finnish (Kiparsky 1968), Spanish (Piera 1980), Chinese (Yip 1984), Serbo-Croatian (Jakobson 1952), and other languages. The stress profiles of tetrameters often show stress peaks in the two colon-final feet (Bailey 1975; Tarlinskaja 1976), again reinforcing symmetry.

Exactly the same reasoning predicts correctly that no foot pattern may contain one strong and three weak positions; there is no way such a foot can be bracketed to satisfy Even Distribution.

In pentameters, the unmarked provision of even distribution is unsatisfiable. The marked provision is met by two basic structures:

(26) a. *2+3 pentameter* b. *3+2 pentameter*



Piera (1980) convincingly argues that in Spanish, the two structures can be freely mixed in the same poem. He proposes that the basic pattern for pentameter is normally just a linear sequence of five feet, and that the general principle of Even Distribution freely provides the two options. In other pentameter traditions, only the 2+3 structure is available (cf. Serbo-Croatian decasyllables, Renaissance English verse, Chinese (Yip 1984), and some Romance verse forms). Piera suggests that 2+3 is the unmarked bracketing, and relates this claim to the general rhythmic principle that longer elements are placed after shorter ones (cf. Allen 1973:119–20).

Piera's ideas can help account for some of the diachronic shifts that have been observed in the metrical practice of Shakespeare. As Shakespeare's career evolved, he gradually carried out the following changes. First, the second most frequently stressed position in the line (after the main peak in position ten) shifts from position four to position six (Tarlinskaja 1983, 198–). Further, the second most frequent location of phonological phrase breaks (after line boundary) shifts from just after position four to just after position six (Oras 1960). Both changes reflect a shift from the unmarked 2+3 structure towards the more sophisticated 3+2. The shifted colon boundary behaves like a pale version of a line boundary, attracting both stress and phrase breaks.

Recall that 2+3 is the 'unmarked case' only in the context of the pentameter, which inherently cannot achieve strict Even Distribution. The truly unmarked case is found only in meters that satisfy the constraint

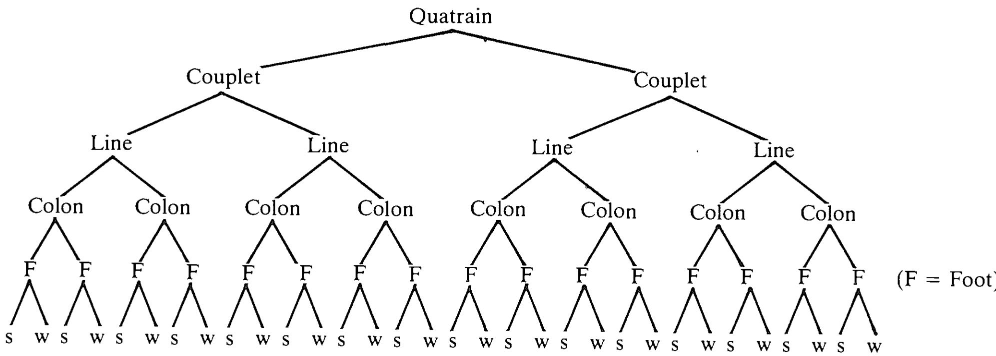


Figure 9. The nursery rhyme quatrain

completely; these are necessarily based on powers of two. A plausible place to find fully unmarked meters is in verse intended for those in the early stages of acquiring metrical competence – that is, in nursery rhymes. The work of Burling (1966) is striking in this regard. Burling collected nursery rhymes from a wide variety of unrelated languages, and discovered that they all fit a common rhythmic archetype. The lines of this archetype have four feet, and from syntactic evidence appear to be divided into two-foot cola. Lines are grouped by both rhyme and syntax into couplets, and the couplets pair off into quatrains. Thus in English we have:

(27) Péter, Péter, / púmpkin eáter,
Hád a wífe and / cóuldn't kéep her,
- -
Pút her ín a / púmpkin shéll, (and)
Thére he képt her / véry wéll.

This pattern clearly reflects Even Distribution, carried through in the most thorough possible way. The full metrical pattern of a quatrain (see Figure 9) pairs symmetrical constituents to a substantial depth of embedding. Burling found similar patterns in Chinese, Bengkulu, Cairene Arabic, Yoruba, Serrano, Trukese, and Ponapeian.

Further support for Even Distribution in children's verse comes from 'silent feet'. These occur at the edge of what appear superficially to be three-beat lines, as in (28):

(28) Híckory, díckory, dóck, ∅
The móuse ran úp the clóck. ∅
The clóck struck óne, the móuse ran dówn,
Híckory, díckory, dóck. ∅

The existence of these silent feet is most strongly supported by recitation: an

obligatory pause signals the missing foot. A recitation that simply followed the inherent linguistic rhythm would be non-idiomatic. Further evidence for silent beats is pointed out in Attridge (1982), Hayes (1984b), and Stein & Gil (1980).

Silent feet occur only in tetrameter verse, where they permit the strictest version of Even Distribution to be satisfied. I take this as significant evidence in favor of Even Distribution; readers presumably only insert 'fictional' pauses when an overriding general principle tells them that pauses are to be expected. The widespread linguistic distribution of tetrameter rhythm and silent beats in children's verse argues that Even Distribution may be an innate principle of unmarked rhythmic form.

The study of metrical patterns is a very early stage, though I think it shows great promise. One implication for phonological theory appears already to have emerged from this work: rhythmic structure in the general sense embodies not just a pattern of relative prominence, but also a grouping of rhythmic elements into constituent structure. The Metrical theory of stress currently faces a controversy over precisely this issue; cf. 12.4.2. If stress is the linguistic instantiation of rhythmic structure, then the clear example of rhythm in meter suggests that linguistic stress should involve constituency as well. In my view, this agrees with what the purely phonological evidence would indicate.

12.6. Conclusion: the content of universal metrics

Generative metrics has patterned its long-term goals after those of generative linguistics: we wish first to provide adequate factual coverage of individual metrical systems; then psychologically valid accounts of the rules that underlie these systems; and finally a statement of the universal principles on which all metrical systems are founded. In other words, we seek observational, descriptive, and explanatory adequacy. Interesting accounts of these goals as they relate to metrics may be found in Piera (1980) and Gil & Shoshany (forthcoming).

I would conjecture, however, that explanatory adequacy for metrical theory will involve a rather different kind of answer than what emerges from linguistics proper. In particular, I suspect that there may be no such field as 'universal metrics' *per se*. I base my conjecture on the vastly differing importance of linguistic and metrical competence for human beings. Chomsky (1980) has argued that true linguistic capacity is unique to humans; that we possess a specialized 'mental organ' dedicated to linguistic knowledge and processing. It is not obvious that the selective advantage provided by our linguistic abilities is also conferred by the ability to compose or appreciate metrical verse.

It seems more likely that metrical ability is an overlaid function, tapping into both linguistic competence and 'rhythmic competence.' Our understanding of the latter is less developed than our knowledge of linguistics, but it is clear that such a mental domain must exist, given the wide variety of things people do in regular rhythms. There are clearly general principles that govern rhythmic activity, among them (a) the tendency of rhythmic beats towards isochrony; (b) the existence of hierarchy, with stronger beats spaced at wider intervals; (c) the iambic/trochaic law: iambic, but not trochaic units tend to be reinforced with durational contrast. These principles govern other activities beyond verse, and arguably have direct effects in phonology itself (Hayes 1984a, 1985; Selkirk 1984).

The one aspect of metrics that may initially seem purely 'metrical' is the notion of correspondence; the task of determining a well-formed mapping between distinct rhythmic structures. But even this may reflect an ability that is more general; for example, Liberman (1975) suggests that the alignment of intonational contours with varying texts forms essentially a task of matching up two independent rhythmic structures.

If this conjecture concerning universal metrics is right, then two things follow. First, metrists should be wary of putative metrical principles stated in a way that is extremely specific to metrics. Such principles are unlikely to be sufficiently general. Second, if universal metrics is indeed derivable entirely from principles of other domains, then it can serve as very direct evidence for what those principles are. As research continues, both phonologists and psychologists of rhythm should find the results of metrics to be of increasing relevance and importance to their own work.

REFERENCES

Allen, W. S. 1973. *Accent and rhythm*. Cambridge: Cambridge University Press.

Anderson, S. 1973. U-umlaut and Skaldic verse. In S. Anderson & P. Kiparsky (eds.) *A festschrift for Morris Halle*. New York: Holt, Rinehart & Winston.

Anderson, S. 1982. Differences in rule type and their structural basis. In H. van der Hulst & N. Smith (eds.) *The structure of phonological representations (part II)*. Dordrecht: Foris.

Attridge, D. 1982. *The rhythms of English poetry*. London: Longman.

Bailey, J. 1975. *Toward a statistical analysis of English verse*. Lisse: Peter de Ridder Press.

Bjorklund, B. 1978. *A study in comparative prosody: German and English iambic pentameter*. Stuttgart: Verlag Hans-Dieter Heinz.

Brogan, T. 1980. *English versification 1570–1980: a reference guide with a global appendix*. Baltimore: Johns Hopkins University Press.

Burling, R. 1966. The metrics of children's verse: a cross-linguistic study. *American Anthropologist* 68: 1418–41.

Buss, K. 1974. Stress placement in Milton's verse: implications for the Halle–Keyser theory of English iambic pentameter. Doctoral dissertation, Brandeis University.

Chatman, S. 1965. *A theory of meter*. The Hague: Mouton.

Chen, M. 1979. Metrical structure: evidence from Chinese poetry. *Linguistic Inquiry* 10: 371–420.

Chen, M. 1980. The primacy of rhythm in verse. *Journal of Chinese Linguistics* 8: 15–41.

Chomsky, N. 1980. *Rules and representations*. New York: Columbia University Press.

Chomsky, N. & Halle, M. 1968. *The sound pattern of English*. New York: Harper & Row.

Clements, G. N. 1978. Tone and syntax in Ewe. In D. Napoli (ed.) *Elements of tone, stress, and intonation*. Washington: Georgetown University Press.

Clements, G. N. & Keyser, S. J. 1983. *CV phonology: a generative theory of the syllable*. Cambridge, MA: MIT Press.

Devine, A. & Stephens, L. 1984. *Language and metre: resolution, Porson's bridge, and their prosodic basis*. Chico: Scholars Press.

Dillon, G. L. 1977. Kames and Kiparsky on syntactic boundaries. *Language and Style* 10: 16–22.

Elwell-Sutton, L. P. 1976. *The Persian meters*. Cambridge: Cambridge University Press.

Evans, B. 1974. *The Riverside Shakespeare*. Boston: Houghton Mifflin Co.

Giegerich, H. 1985. *Metrical phonology and phonological structure: German and English*. Cambridge: Cambridge University Press.

Gil, D. & Shoshany, R. Forthcoming. On the nature of prosodic competence. Dept. of Linguistics, Tel Aviv University. ms.

Halle, M. & Keyser, S. J. 1969. Chaucer and the study of prosody. *College English* 28: 187–219.

Halle, M. & Keyser, S. J. 1971. *English stress: its form, its growth, and its role in verse*. New York: Harper & Row.

Halle, M. & Vergnaud, J. -R. 1987. Stress and the cycle. *Linguistic Inquiry* 18: 45–84.

Hammond, M. 1984. Constraining metrical theory: a modular theory of rhythm and destressing. Doctoral dissertation, UCLA, Los Angeles, Calif. Distributed by Indiana University Linguistics Club.

Hayes, B. 1979. The rhythmic structure of Persian verse. *Edebiyāt* 4: 193–242.

Hayes, B. 1980. *A metrical theory of stress rules*. Doctoral dissertation, MIT. Published 1985, New York: Garland.

Hayes, B. 1982. Extrametricality and English stress. *Linguistic Inquiry* 13: 227–76.

Hayes, B. 1983. A grid-based theory of English meter. *Linguistic Inquiry* 14: 357–93.

Hayes, B. 1984a. The phonology of rhythm in English. *Linguistic Inquiry* 15: 33–74.

Hayes, B. 1984b. Review of Attridge (1982). *Language* 60: 914–23.

Hayes, B. 1985. Iambic and trochaic rhythm in stress rules. In M. Niepokuj, M. VanClay, V. Nikiforidou & D. Feder (eds.) *BLS* 11.

Hayes, B. Forthcoming. The prosodic hierarchy in meter. In Kiparsky & Youmans (forthcoming).

Heny, J. 1981. Rhythmic elements in Persian poetry. Doctoral dissertation, University of Pennsylvania.

Hock, H. H. 1980. Archaisms, morphophonemic metrics, or variable rules in the Rig-Veda? *Studies in the Linguistic Sciences* 10,1: 59–69. Urbana: Dept. of Linguistics, University of Illinois.

Jakobson, R. 1933. Über den Versbau der serbokroatischen Volksepen. *Archives néerlandaises de phonétique expérimentale* 7–9: 44–53. Reprinted in Jakobson (1966).

Jakobson, R. 1952. Slavic epic verse: studies in comparative metrics. *Oxford Slavonic papers* 3: 21–66. Reprinted in Jakobson (1966).

Jakobson, R. 1960. Linguistics and poetics. In T. Sebeok (ed.) *Style in language*. Cambridge, MA: MIT Press.

Jakobson, R. 1966. *Selected writings IV: Slavic epic studies*. The Hague: Mouton.

Jakobson, R. 1974. *Über den tschechischen Vers*. Konstanz: Verlag K. Presse. German translation of the combined text of *O češskom stiche* (Berlin, 1923) and *Základy českého verše* (Prague, 1926).

Jespersen, O. 1933. Notes on metre. *Linguistica*. Copenhagen: Levin & Munksgaard.

Kenstowicz, M. & Kisseberth, C. 1979. *Generative phonology: description and theory*. New York: Academic Press.

Keyser, S. J. 1969. Old English prosody. *College English* 30: 331–56.

Kiparsky, P. 1968. Metrics and morphophonemics in the *Kalevala*. In C. Gribble (ed.) *Studies presented to Professor Roman Jakobson by his students*. Cambridge, MA: Slavica.

Kiparsky, P. 1972. Metrics and morphophonemics in the *Rigveda*. In M. Brame (ed.) *Contributions to generative phonology*. Austin: University of Texas Press.

Kiparsky, P. 1973. The role of linguistics in a theory of poetry. *Daedalus* 102: 231–45.

Kiparsky, P. 1975. Stress, syntax, and meter. *Language* 51: 576–616.
Kiparsky, P. 1977. The rhythmic structure of English verse. *Linguistic Inquiry* 8: 189–247.
Kiparsky, P. Forthcoming. Sprung rhythm. In Kiparsky & Youmans (forthcoming).
Kiparsky, P. & Youmans, G. Forthcoming. *Rhythm and meter*. Orlando: Academic Press.
Kisseberth, C. & Abasheikh, M. 1974. Vowel length in Chi-Mwi:ni – a case study of the role of grammar in phonology. In A. Bruck, R. Fox, & M. LaGaly (eds.) *Papers from the parasession on natural phonology*. Chicago: Chicago Linguistic Society.
Koster, J. 1983. Untitled ms., Vakgroep Algemene Literatuurwetenschap, Rijksuniversiteit te Leiden, The Netherlands.
Liberman, M. 1975. The intonational system of English. Doctoral dissertation, MIT. Distributed by the Indiana University Linguistics Club.
Liberman, M. & A. Prince 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8: 249–336.
Magnuson, K. & Ryder, F. 1970. The study of English prosody: an alternative proposal. *College English* 31: 789–820.
Magnuson, K. & Ryder, F. 1971. Second thoughts on English prosody. *College English* 33: 198–216.
Malone, J. 1982. Generative phonology and Turkish rhyme. *Linguistic Inquiry* 13: 550–3.
Malone, J. 1983. Generative phonology and the metrical behavior of *U-* 'and' in the Hebrew poetry of medieval Spain. *Journal of the American Oriental Society* 103: 369–81.
Malone, J. 1984. Generative phonology and Early Irish alliteration. Dept. of Linguistics, Barnard College, New York. ms.
McCarthy, J. 1979. On stress and syllabification. *Linguistic Inquiry* 10: 443–66.
McHugh, B. 1987. Syntactic structure, empty categories and phrasal phonology in Chaga. In D. Odden (ed.) *Current approaches to African linguistics, vol. 4.* Dordrecht: Foris.
Nespor, M. & Vogel I. 1982. Prosodic domains of external sandhi rules. In H. van der Hulst & N. Smith (eds.) *The structure of phonological representations, part I.* Dordrecht: Foris.
Odden, D. 1984. The phrasal phonology of Kimatuumbi. Dept. of Linguistics, Yale University. ms.
Oras, A. 1960. *Pause patterns in Elizabethan and Jacobean drama: an experiment in prosody*. Gainesville: University of Florida Press.
Piera, C. 1980. Spanish verse and the theory of meter. Doctoral dissertation, UCLA.
Prince, A. 1983. Relating to the grid. *Linguistic Inquiry* 14: 19–100.
Prince, A. Forthcoming. Metrical forms. In Kiparsky & Youmans (forthcoming).
Schane, S. 1972. Noncyclic English word stress. Dept. of Linguistics, University of California, San Diego. ms.
Schlerman, B. 1984. The meters of John Webster. Doctoral dissertation, University of Massachusetts, Amherst. Available from the University of Massachusetts Graduate Linguistics Student Association.
Selkirk, E. 1978. On prosodic structure and its relation to syntactic structure. In T. Fretheim (ed.) *Nordic prosody II*. Trondheim: TAPIR.
Selkirk, E. 1980a. The role of prosodic categories in English word stress. *Linguistic Inquiry* 11: 563–605.
Selkirk, E. 1980b. Prosodic domains in phonology: Sanskrit revisited. In M. Aronoff & M.-L. Kean (eds.) *Juncture*. Saratoga: Anma Libri.
Selkirk, E. 1981. On the nature of phonological representation. In J. Anderson, J. Laver & T. Myers (eds.) *The cognitive representation of speech*. Amsterdam: North-Holland.
Selkirk, E. 1984. *Phonology and syntax: the relation between sound and structure*. Cambridge MA: MIT Press.
Smith, G. S. 1980. *Metre, rhythm, stanza, rhyme*. Russian poetics in translation 7. Oxford: Holdan Books.
Spevack, M. 1973. *The Harvard concordance to Shakespeare*. Cambridge, MA: Belknap Press of Harvard University Press.
Stein, D. & Gil, D. 1980. Prosodic structures and prosodic markers. *Theoretical Linguistics* 7: 173–240.
Tarlinskaja, M. 1976. *English verse: theory and history*. The Hague: Mouton.
Tarlinskaja, M. 1983. Evolution of Shakespeare's metrical style. *Poetics* 12: 567–87.
Tarlinskaja, M. 1984. Rhythm–morphology–syntax–rhythm. *Style* 18: 1–26.

Tarlinskaja, M. 198–. Shakespeare's verse: iambic pentameter and the poet's idiosyncrasies. Unniversity of Washington, Seattle. ms.
Yip, M. 1980. The metrical structure of regulated verse. *Journal of Chinese Linguistics* 8: 107–25.
Yip, M. 1984. The development of Chinese verse: a metrical analysis. In M. Aronoff & R. T. Oehrle (eds.) *Language sound structure: studies in phonology presented to Morris Halle by his teacher and students*. Cambridge, MA: MIT Press.
Youmans, G. Forthcoming. Milton's meter. In Kiparsky & Youmans (forthcoming).
Zeps, V. 1963. On the meter of the so-called trochaic Latvian folk songs. *International Journal of Slavic Linguistics and Poetics* 7: 123–8.
Zeps, V. 1969. The meter of the Latvian folk dactyl. *Celi* 14: 45–7.
Zeps, V. 1973. Latvian folk meters and styles. In S. Anderson & P. Kiparsky (eds.) *A festschrift for Morris Halle*. New York: Holt, Rinehart & Winston.
Žirmunskij, V. 1966. *Introduction to metrics*. The Hague: Mouton.