Stress, Meter, and Text-setting*

Paul Kiparsky

1 Rhythm and stress

Rhythm in language and in poetry, music, and dance differs in four respects from biological and physical rhythm, such as that of heartbeats, circadian rhythm, and phases of the moon.

First, whereas each tick of a watch, and each beat of a healthy heart, is identical to the next, rhythm in language and art is based on an ALTERNATION between prominent and non-prominent beats (stressed/unstressed, strong/weak, downbeat/upbeat):

(1) a. Biological and physical rhythm: . . . × × × × × × × × × × × × × × × × × × × . . .

b. Rhythm in language and art: . . . × . . .

The mind perceives alternating periodicity even in an objectively even sequence of beats: we hear the "tick-tick" of a watch as "tick-tock".

Secondly, the prominent beats in turn alternate between more prominent and less prominent beats, recursively up to a unique rhythmic peak of the rhythmic domain. This intersecting periodicity generates a PROMINENCE HIERARCHY, represented by a grid or tree (Liberman & Prince 1977).

Third, prominent beats at each level are grouped with preceding or following less prominent beats into rhythmic CONSTITUENTS.

(2) . . . × . . .

In the theory of language and verse these three aspects of rhythm are usually represented by bracketed grids or labeled trees; the two notations convey exactly the same information.

*Thanks to Elan Dresher for his careful reading of a draft of this article.

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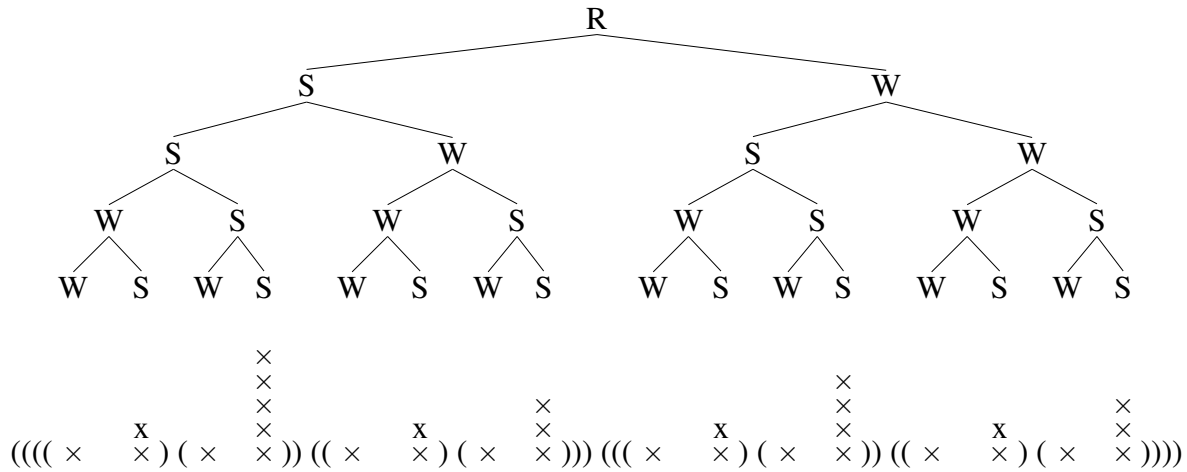
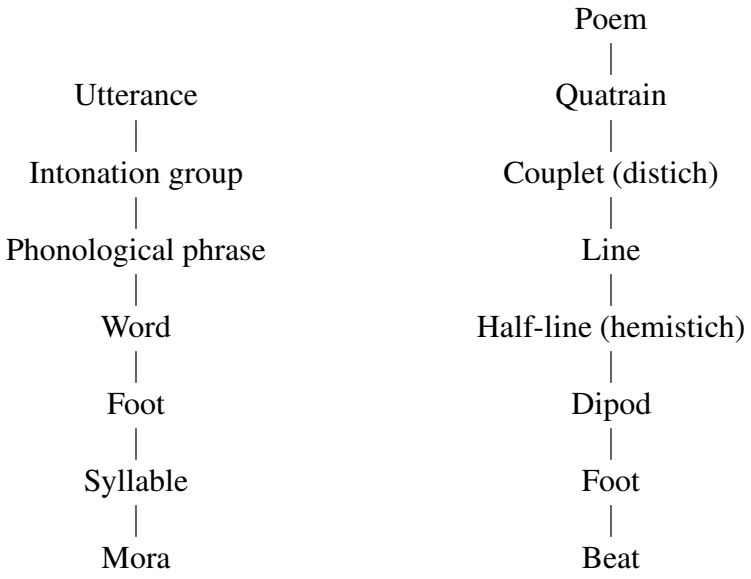


Finally, certain constituents in the hierarchy form LEVELS with substantive properties of their own. In phonology, these constituents make up the PROSODIC HIERARCHY; its stylized counterpart in verse is the METRICAL HIERARCHY, which appears to be strictly binary and hence does not necessarily map onto the prosodic one.

(4) (a) Prosodic hierarchy (in language) (b) Metrical hierarchy (in verse)



Interesting theories of foot structure and of phrasing have been developed both in phonology and in metrics. All poetry avoids mismatches between metrical and linguistic prominence, but in ways that depend on the level of the hierarchy at which the mismatch occurs, and that vary between languages and periods (see p. 6 for an example).

The prosodic and metrical hierarchies are subject to STRICT LAYERING, a violable constraint which militates against skipping levels and against improper bracketing (Itô and Mester 2003[1992]).

(5) STRICT LAYERING

a. A non-terminal unit of the prosodic hierarchy, X^p, is composed of one or more complete units of the immediately lower category, X^{p-1}.

b. A non-root unit of a prosodic hierarchy, X^p, is completely contained in a unit of the immediately superordinate category, X^{p+1}.

The two hierarchies are preferentially aligned:

(6) ALIGNMENT

Align linguistic constituents (words, phrases, sentences) with metrical constituents (feet, dipods, cola, lines, stanzas).

2 Meter

Verse structure has been studied in many disciplines and from a remarkably diverse range of theoretical perspectives. GENERATIVE METRICS is an approach to the theory and typology of versification that takes linguistics both as a methodological model and as a source of explanatory principles. It goes beyond inventories of metrical repertoires to the "grammars" that underlie them, seeking the constraints that delimit the typological space within which those grammars are situated. This approach is motivated by the fact that meter is doubly grounded in language. Language itself is already rhythmically organized by the prominence-defining features of stress, phrasing, and syllable weight. Metrics superimposes a second layer of rhythmic organization on this inherent linguistic rhythm, governed by formally and substantively language-like internalized constraints which are productive yet largely unarticulated and intuitive. This explains why verse structure can be robustly perceived even from partial, indirect, and variable rhythmic cues – why, in particular, silent beats are perceived as structural elements in verse.[1] On this conception of meter, metrical constraints assign a text an intrinsic metrical form, which may – but need not – be reflected in the way it is recited, sung, or set to music.

By regularizing the distribution of prominence-defining phonological features, metrical constraints make verse the simplest, unmarked form of literary language — indeed in many oral traditions across the world the first or only form of literature. In fact, *all* metrical verse is in principle oral, for writing systems reflect prominence-defining phonological features imperfectly if at all, and graphic features such as the shapes of letters or the spelling of words are irrelevant to meter. Spacing and line breaks on a page are not constitutive elements of verse but graphic cues to phonological phrasing and lineation. Any particular metrical system is obviously a complex product of cultural history and functional pressures which push the repertoire to be as expressive as necessary (FIT) and as restrictive as possible (INTEREST); see Hanson & Kiparsky 1996. The marked counterpart of verse is literary prose, a more complex form distinguished by rhythmic variety, and often by the avoidance of metrical cadences.

The hypothesis that metrical form is a stylization of phonological form predicts a typology of possible metrical systems. A surprising prediction is that lineation and length restrictions are not defined by counting feet or other units – for phonology cannot count past two – but rather by the abstract hierarchical organization of the categories in (4b). Accordingly an iambic pentameter is

[1] In all metrical verse silent beats are preferentially placed at the ends of constituents. We have *eeny, meeny, miny, moe* and not **moe, miny, meeny, eeny*; the quatrain type 4443 (tetrameter with a catalectic final line) is a common ballad stanza, whereas 3334 is unheard of. Blumenfeld (MS.) explains that this maximizes the cohesion of constituents, whereas putting silents beats inside them would disturb it.

not just a sequence of five iambs – it has a hierarchical metrical structure made up of the units in (4b). Section 4 summarizes some of the evidence that supports this prediction.

Space does not permit a full review of the many approaches to generative metrics currently being explored (see Blumenfeld 2015 for an excellent survey and an interesting new perspective). A popular line of investigation which has proved productive treats meter as a mapping of abstract verse patterns ("templates") to their permissible linguistic instantiations. Both can be represented by bracketed grids or labeled trees as in (3). The metrical parse of the linguistic instantiations is dictated by the grammar of the language, though in some traditions meter accesses a special poetic variety of the language. The abstract verse patterns can be characterized by systems of ranked Optimality-Theoretic markedness constraints, in part culturally determined and historically contingent within the limits imposed by the faculty of language. The mapping between them can be formalized by Optimality-Theoretic correspondence constraints. The output is a METRICAL ANALYSIS of a text, which specifies whether it instantiates (legitimately corresponds to) a given abstract metrical pattern, and if so, how complex the instantiation is, as measured by the licensed mismatches it incurs. The close empirical connection between metrical conventions and text-setting practices motivates including text-setting in the theory of meter.

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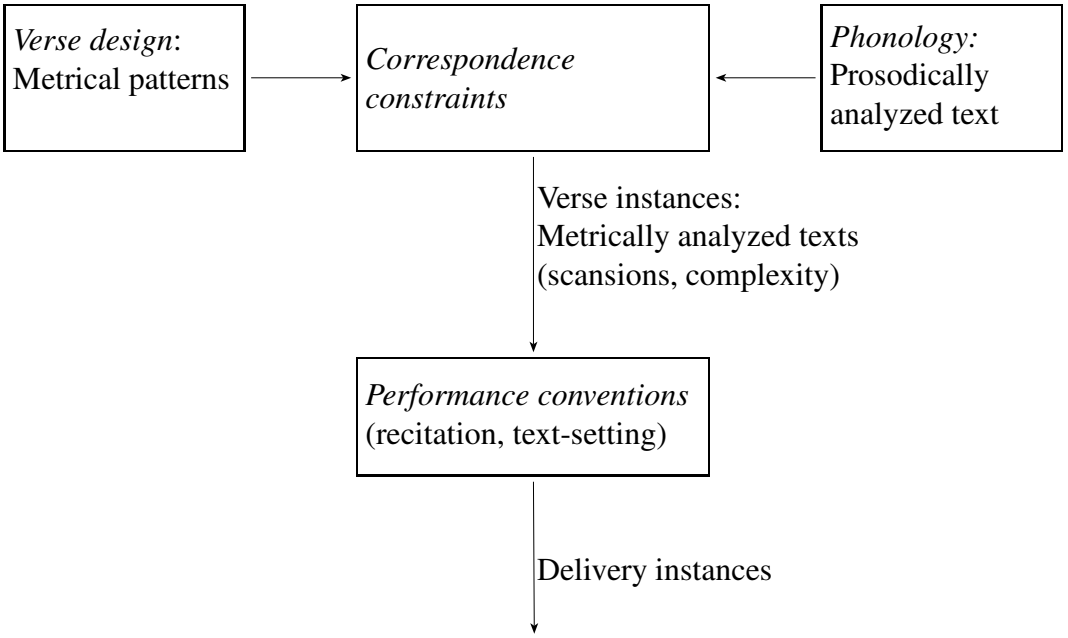


3 Prominence

The realization of verse meter is tied to the language's prominence-marking categories, either syllable weight, stress, or pitch. A meter may require prominence in Strong positions, or non-prominence in Weak positions, or both. This can be illustrated with the typology of quantitative meters. All such meters are based on a binary distinction between LIGHT (monomoraic) syllables, which end in a short vowel, and HEAVY (bimoraic or longer) syllables. Languages with major bodies of quantitative poetry are classical Greek, Latin, Arabic, Persian, Urdu, Ottoman Turkish, Hausa, Somali, and Hungarian; quantitative constraints interact with stress in the poetries of Finnish, Dravidian, and Serbo-Croatian (Ryan, in press). With the exception of Turkish, syllable

weight is important in the phonologies of these languages as well, playing a role, among other things, in the placement of stress.[2]

The typology is given by the following menu of constraints:

(8) a. Strong positions
    1. Must be a bimoraic foot ⏑⏑ (less restrictive)
    2. Must be a bimoraic syllable – (more restrictive)

b. Weak positions
    1. Cannot be a bimoraic foot ⏑⏑ (more restrictive)
    2. Cannot be a bimoraic syllable – (less restrictive)

Note that a meter in which both (a2) and (b1) are enforced is isosyllabic.

The various binary meters of Greek and Latin exploit all these options.[3]

(9) a. Strict iambic verse, with feet of the form (⏑ –): (8a2), (8b1)

b. Iambic with resolution in S, with feet of the form (⏑ ⏑⏑): (8a1), (8b1)

c. Iambic with resolution in S and split W, with feet of the form (⏒ ⏑⏑): (8a1), (8b2)

In ternary quantitative meters, both S and W are bimoraic (moraic trochees), and the correspondence constraints on positions determine the distribution of their monosyllabic and disyllabic realizations.

The meter of English is based on stress (some varieties of it also on syllable weight). Stress affects the temporal organization of the utterance and provides the inflection points for intonation contours. The local cues for stress in English are pitch, duration, loudness, and the distribution of certain segmental phonological features, such as vowel reduction in unstressed syllables and tapping of coronal stops before them (*atom* [ǽɾəm], *atomic* [ətʰǽmɨk]).

Like quantitative meters, stress-based meters can require prominence in Strong positions, and/or non-prominence in Weak positions. Prominence in stress-based meters is usually defined by STRESS PEAKS, syllables bearing the strongest stress in some domain – a foot, a word, or a phrase. E.g. *phi**ló**sophy* and *phi**ló**sophìze* have one peak in each domain (boldfaced); *phi**ló**so**phì**zing* has two foot peaks but still just one word peak, and *tìme **pást*** has only a phrasal peak.

(10) a. CONSTRAINT ON STRONG POSITIONS: a Strong position must contain a stress peak.

b. CONSTRAINT ON WEAK POSITIONS: A Weak position cannot contain a stress peak.

Ballad meter and other folk meters of English obey (10a). The standard literary binary meters, the most important of which is iambic pentameter, do not obey it. Instead, they impose one of the forms of (10b) (varying in what counts as a peak), which holds except for verse-initial and phrase-initial position. For example, Milton bars phrasal peaks in Weak positions, while Shakespeare only bars word peaks in Weak positions (Kiparsky 1977).

[2] In (8) and (9) ⏑ stands for a light syllable, – for a heavy syllable, and ⏑⏑ for a heavy syllable or two light syllables.

[3] In Greek, (9a) is common in early lyrical verse, (9b) in tragedy, and the least restrictive (9c) in satyric drama and comedy, see Wilamowitz-Möllendorff 1921: 290-293 (*Doppelsenkungen*), West 1982: 88-93.

Micro-variation in the correspondence constraints and in the prosodic phonology of poetic language generates a vast palette of metrical "dialects" or "styles", especially in major meters like iambic pentameter. The following section illustrates the generalizations of sections (1)-(2) with the blank verse of Shakespeare's plays.[4]

4 English meter

The basic iambic pentameter template is (11).

(11) *Iambic pentameter*

a. Basic pattern: five feet, each containing two positions (iambic, Weak-Strong).

b. At the end of a verse and before a phrase boundary, an additional Weak position is allowed (an EXTRAMETRICAL syllable), shown by a slur .

The principal correspondence constraints are those in (12).

(12) a. CONSTRAINT ON POSITIONS: A position contains one syllable. (Obeyed in standard binary meters of English, except under the conditions specified below.)

b. CONSTRAINT ON WEAK POSITIONS: A Weak position cannot contain a stress peak. (Obeyed in standard binary meters of English, except for verse-initial and phrase-initial position.)

Compare the examples from Shakespeare in (13) with the starred unmetrical constructs that violate the Weak Position Constraint.

(13) a. 1. There are / more things / in heaven / and earth, / Hora tio
Than are / **dreamt of** / in your / philo/sophy (*Hamlet* 1.5.165-6)
2. *Than you / **posit** / in your / philo/sophy (construct)
3. *Than i/**magined** / in your / philo/sophy (construct)

b. 1. With cold / pale weak/ness numbs / each feel/ing part (*V.&A.* 892)
2. *With ma/**lign** weak/ness be/**numbs** feel/ing parts (construct)

c. 1. Pluck the / **keen** teeth / from the / **fierce** ti/ger's jaw (*Sonnet* 10)
2. *Pluck im/**mense** teeth / from en/**raged** ti/gers' jaws (construct)

The blank verse of Shakespeare's plays allows two or more syllables to occupy one position by two sets of processes: ELISION, the phonological reduction of two syllables to one, and RESOLUTION, the metrical licensing of two syllables in one position.

Elision is in turn of two types: SYNCOPE and CONTRACTION.

[4] A more regimented (simpler) form of iambic pentameter appears in his sonnets and narrative poems (Hanson 2006).

(14) SYNCOPE: a vowel can be elided if it is followed within the same word by a sonorant and an unstressed vowel, when preceded by a stressed syllable.

a. Whose womb / unmea/surable / and in/**finite** breast (*TIM* 4.3.178)

b. When I / return / with vic/**tory** from / the field (*H6.3* 1.1.278)

Syncope usually does not apply at the end of a line or before a break. Syncope remains a live process in modern English, e.g. e.g. *infinite* → *inf'nite*, *gén(e)rative*, vs. *géneràte*.

(15) CONTRACTION: adjacent vowels can be reduced to one, e.g. *being, prayer*.

a. Doing / himself / offence; / whilst we, / **lying** still (*JC*)

b. Can lay / to bed / for ever; / whiles you, / **doing** thus (*TMP* 2.1.284)

c. For the / main soldier: / whose qua/lity, / **going** on, (*ANT*)

d. He thinks, / **being** twen/ty times / of bet/ter fortune, (*ANT*)

e. A sooth/**sayer** bids you / beware / the Ides / of March (*JC* 1.2.19)

A few words allow contraction across *v*: *ne'er, o'er, e'en*, but not **cle'er, *clo'er, *bea'er*.

Unlike elision, Resolution is a metrical constraint that licenses the placement of two syllables in one position. Being a metrical constraint, (1) it is restricted to specific meters, (2) it is sensitive to metrical (S vs. W) position, and (3) it is not reflected in actual pronounciation. There are two types: W-Resolution and F-Resolution.

(16) W-RESOLUTION: A light stressed syllable followed by another syllable within the same word can occupy a single Strong metrical position.

a. $\left\{\begin{array}{l}\text{Ty}\textbf{ranni}\text{/cal}\\ *\textbf{Identi}\text{/cal}\end{array}\right\}$ power: / if he / evade / us there

b. And spends / his $\left\{\begin{array}{l}\textbf{prodi}\text{/gal}\\ *\textbf{whimsi}\text{/cal}\end{array}\right\}$ wits / in boot/less rhyme

c. Of god/like $\left\{\begin{array}{l}\textbf{ami}\text{/ty}\\ *\textbf{chasti}\text{/ty}\end{array}\right\}$; which / appears / most strongly (*MV* 3.4.3)

(17) F-RESOLUTION: Two function words (usually preposition + *the*) can occupy a single Weak position.

a. I' the midst / o' the bo/dy, id/le and / unactive (COR 1.1.97)

b. Thus do / they, sir: / they take / the flow / **o' the** Nile
By cer/tain scales / **i' the** py/ramid; / they know, (*ANT* 2.7.19)

c. So dry / he was / for sway / — **wi' the** King / of Naples (*Tempest* 1.2.112)

Elision, resolution, and extrametricality may be combined to yield feet of up to five syllables.

(18) a. And take / my milk / for gall, / you mur/dering **mini**sters (*MAC* 1.5.49)

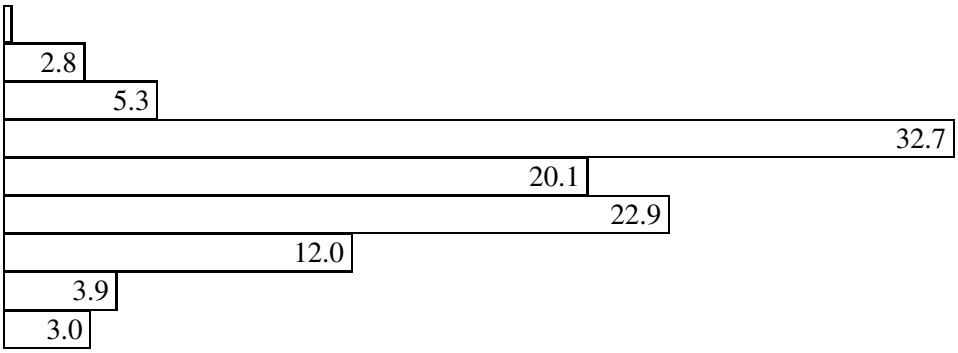
b. What's He/cuba / to him, / or he / to **Hecu**ba (*HAM* 2.2.585)

c. Some griefs / are **medi**/cina/ble; that / is one of them (*CYM* 3.2.33)

d. With a / discove/ry of / the in/finite **flatte** ries (*TIM* 5.1.36)

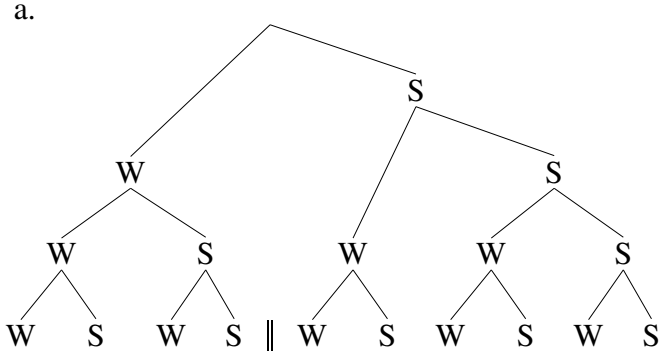
In Shakespeare's blank verse, the feet are most commonly grouped as 2+3, with a caesura after the fourth syllable. (19) (from Keppel-Jones 2001: 234) shows the percentages of caesuras after each position.

(19)

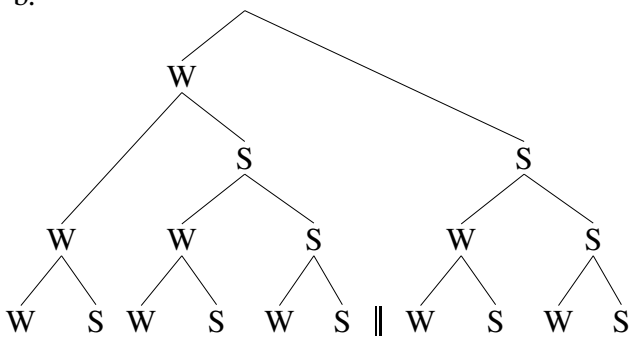


This suggests that the basic structure of Shakespeare's line is is (20a), rather than (20b).[5]

(20) a.



b.



[5]This is consistent with Blumenfeld's silent beat-based account of short-last effects in metrical verse (fn. (1)), for there is no reason to posit silent feet in pentameters, and in any case the highest layer of constituency in blank verse is the line, so that putting the shorter hemistich last gains no cohesion over putting the longer one last. The right-branching is (20a) thus reflects the general stylistic long-last preference, cf. *Bell, book, and candle; Sex, Lies, and Videotape; The Bold and the Beautiful; men and women; ladies and gentlemen*.

Varying the placement of the caesura in successive lines (internal enjambement) is an important feature of verse.

In neoclassical iambic pentameter distichs (heroic couplets) a caesura after the fifth position becomes more common. Dividing the line into two constituents of equal size privileges the PARALLELISM constraint, ubiquitous in meter and music (Lerdahl & Jackendoff 1983: 51), over STRICT LAYERING and ALIGNMENT. In the 19th century the caesura begins to move still further rightward; Browning favors it after the sixth beat in his early work and after the seventh beat in his later work.

5 Explaining the metrical constraints

The rich typological generalizations that emerge from the typology of metrical systems beg for explanation. Ideally the generalizations should follow from interactions among the constraints that are descriptively motivated by the attested systems.

Why does W-resolution occur only in Strong positions, and F-resolution only in Weak positions? W-resolution in Weak positions would violate the Weak position Constraint, which is otherwise strictly obeyed. 21 presents a near-minimal pair that shows the contrast between elision and resolution.

(21) { A sooth/**sa͡yer** / *A truth/**teller** } bids you͡ / beware / the Ides / of March (*JC* 1.2.19)

Conversely, F-resolution in Strong positions would introduce a joint violation of both (10a) and (12a).

(22) a. Whom lep/rosy / o'ertake! — / **i' the midst / o' the** fight, (*ANT* 3.10.11)
b. *Whom lep/rosy / take **i' the** / midst **o' the** / campaign (construct)

Why are lexical stresses of polysyllabic words more restricted than stressed monosyllables? In particular, what makes them less suitable to appear in Weak positions? Suppose that the lexical stresses of polysyllabic words are more SALIENT than those of monosyllabic words, since they contrast with lexically unstressed syllables within the same word. By the same token, *unstressed syllables* of polysyllabic words should be more saliently *unstressed* than those of monosyllabic words, hence even less suited to Strong positions, for they contrast with lexically *stressed* syllables within the same word. These considerations predict a hierarchy of prominence:

(23) Ṕ — a stressed syllable in a polysyllabic word (STRONGEST)
|
Ḿ — a stressed syllable in a monosyllabic word
|
M̆ — an unstressed syllable in a monosyllabic word (necessarily a function word)
|
P̆ — an unstressed syllable in polysyllabic word (WEAKEST)

The following implicational relations are therefore predicted for constraints on Strong and Weak positions:

(24) a. Constraints requiring stress in Strong positions: $\overset{\times}{\text{P}} > \overset{\times}{\text{M}} > \acute{\text{M}} > \acute{\text{P}}$

b. Constraints requiring absence of stress in Weak positions: $\acute{\text{P}} > \acute{\text{M}} > \overset{\times}{\text{M}} > \overset{\times}{\text{P}}$

Variation in English meter provides abundant support for this hierarchy. One example must suffice here: the types of extrametrical syllable permitted in different varieties of English iambic pentameter. The most restrictive system (25a), found in early Marlowe (Schlerman 1989: 200) allows only unstressed syllables of polysyllabic words. The less restrictive system, adopted by Marlowe in his later work (see (25b)), allows also function words (Schlerman 1989: 202). Shakespeare's plays (but not his sonnets) allow extrametrical stressed monosyllables of compound words, as in (25c) (Kiparsky 1977). The least restrictive system, seen in Jacobean dramatists like Fletcher (25d), allows even phrasal peaks in extrametrical positions.

(25) a. Only unstressed syllables of polysyllabic words can be extrametrical.

1. To in/jure or / suppresse / your wor/thy ty**tle** (1.1.183)
2. Because / it is / my coun/tries and / my Fa**thers** (2.4.124)
3. And sit / with Tam/burlaine / in all / his majes**tie** (1.2.209)

b. Also function words can be extrametrical.

1. This sport / is ex/cellent; / wee'l call / and wake **him** (1281)
2. Why waverst **thou?** / O some/thing soun/deth in / mine eares (392)

c. Also stressed monosyllabic lexical words can be extrametrical.

1. Quite o/verca/nopied / with lus/cious wood**bine** (*MND* 2.1.251)
2. That is / the mad**man**: / the lov/er, all / as frantic,

d. Also phrasal stress peaks can be extrametrical.

1. Ten pound / to twen/ty shil/lings, within / these **three weeks**
2. But I / would reach you,/ and bring / you to / your **trot too**.

6 Text-setting

How is a metrical text fitted to the predetermined rhythmic pattern of a song or chant? For English, the short answer is that text-setting generally respects lineation, but otherwise ignores meter in favor of optimal alignment between phonological and musical prominence (Halle and Lerdahl 1993). The overarching constraint is that stressed syllables, especially of polysyllabic words, should be aligned with Strong musical beats, regardless of whether they fall in Strong or Weak positions in the verse. Weak positions in iambic verse can therefore correspond to Strong musical positions and conversely (and indeed must be if the natural stress pattern requires it). For example, Arnold's and Yeats' iambic lines are rendered in Samuel Barber's compositions as shown:

(26) a. 1. *Scansion*: Glimmering | and vast, | out in | the tran|quil bay (Arnold, *Dover Beach*)

2. *Text-setting*: Glímmering and | vást | óut in the | tránquil | báy (Barber, op. 3)

b. 1. *Scansion*: I have | old wo|men's se|crets now (Yeats, *The Secrets Of The Old*)

2. *Text-setting*: Í have | óld women's | sécrets | nów (Barber, op. 13.2)

Some composers are more concerned to match verse meter. Milton Babbitt's text-setting of Hopkins' Sprung Rhythm sonnets reveal a sensitivity to this long misunderstood meter which remarkably anticipates later findings (Kiparsky 1989).

Dell and Halle (2009) show that while English matches stresses to strong beats across the board, French does so only at the end of lines, and that French traditional songs on the other hand require a parallel pairing of syllables to beats in each stanza, which is not the case in English. They propose to derive both differences from the fact that stress in English is perceptually salient throughout the utterance, and only before major breaks in French.

In general, quantitative meters seem to be reflected more faithfully in text-setting than stress meters are (Hayes 2016). Begum Akhtar's ghazal renderings respect syllable count and syllable weight in so far as possible while maintaining Urdu's phonemic vowel length contrast. Metrically prominent positions are sung as long. In words like *gul* 'rose', this is done by extending the note over the vowel and the sonorant coda. In words like *səb* 'all', the closing obstruent cannot carry a note, nor can the phonemically short vowel be lengthened. In strong positions, such words are sung with final -ə inserted as a last resort, which allows their heavy syllables that have only one singable mora to fill the musical space allotted to them. In this exquisite system, faithfulness to syllable weight trumps faithfulness to the syllable count.

The investigation of text-to-tune alignment in cross-linguistic perspective is only beginning, but preliminary results promise rich insights into the relation between the prosodic structure of language, meter, and music.

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