Phonology **12** (1995) 437–464

Review article

Bruce Hayes (1995) *Metrical stress theory: principles and case studies.* Chicago: The University of Chicago Press. Pp. xv+455.

René Kager
University of Utrecht

1 Introduction

This book presents a new and highly articulated version of metrical stress theory, whose major theoretical innovation is an asymmetric foot inventory. The theory is motivated by in-depth analyses of stress patterns of a large number of languages, many of which had not been previously analysed in the metrical literature. From both a descriptive and a theoretical point of view, the book is of great importance to metrical phonologists and to all who are interested in learning more about stress. It presents a wealth of references for further research, and it will no doubt become a standard reference in the metrical literature. It has actually already been widely influential in a manuscript version before its publication, and it is cited in most recent metrical papers. (The book is the result of a full decade of research, at the beginning of which stands the publication of its basic ideas in Hayes (1985, 1987). Draft versions have been circulating from 1991 on.) It also makes a fine textbook in a course on metrical theory at the graduate level. Chapters 2 and 3 are especially useful for those who have no previous knowledge of metrical theory. On the whole, the style of the book is very clear and readable. Cross-references throughout the text facilitate its use, while those who wish to consult this book as a reference work for further research will find three separate indexes of names, languages (and language families) and subjects.

This review is organised as follows. In §§2 and 3 I concentrate on what I consider to be the most important theoretical aspects of the book. §2 addresses the asymmetric foot inventory, and its relationship with (linguistic and extralinguistic) rhythmic principles. §3 considers prohibitions against degenerate feet. §4 reviews the remaining contents of the book, in a chapter-wise fashion. §5 gives conclusions.

2 The asymmetric foot inventory and the Iambic/Trochaic Law

The central thesis of this book is that stress is the linguistic manifestation of rhythmic structure, a claim that has been part of metrical theory ever

since Liberman (1975) and Liberman & Prince (1977). Hayes carefully argues that this claim is even more valid than had been assumed before, since the 'alphabet' of basic metrical elements, the UNIVERSAL FOOT INVENTORY, has a rhythmic basis. This argument runs as follows. There is a widespread cross-linguistic correlation between rhythm type and duration. Languages with trochaic (strong–weak) rhythm are characterised by evenness of duration between the elements of a foot. Accordingly, the canonical trochee is quantitatively balanced, and it contains two light syllables (1b), or two syllables of undiscriminated weight (1a). In contrast, the 'uneven' trochee, a heavy plus a light syllable, is cross-linguistically marginal at best. The picture is reversed in languages with iambic (weak–strong) rhythm: these tend towards uneven duration between the elements of a foot. Accordingly, the canonical iamb (1c) is quantitatively unbalanced, and contains a light syllable followed by a heavy syllable. Although the asymmetric inventory contains only three feet, it suffices to account for the complex and diverse stress patterns of a large number of languages. In Hayes' notation, '⏑' abbreviates a light syllable, and '–' a heavy syllable. (Below I have included the monosyllabic heavy foot in the syllabic trochee, even though this is not part of the inventory on p. 71; it is introduced by Hayes in §5.1.9):

(1) a.	*Syllabic trochee*	(× .)		(×)
		σ σ	*or*	–
b.	*Moraic trochee*	(× .)		(×)
		⏑ ⏑	*or*	–
c.	*Iamb*	(. ×)		(×)
		⏑ σ	*or*	–

The major contribution of Hayes' book to metrical theory is that it demonstrates that this small set of feet suffices to analyse the stress patterns of an enormous number of languages. Earlier work in metrical theory (e.g. Hayes 1980; Halle & Vergnaud 1987) was based on symmetrical foot inventories, but Hayes shows that these theories are less adequate by overgenerating stress patterns, specifically since their inventories contain:

(2) a.	*Syllabic iamb*	(. ×)		(×)
		σ σ	*or*	σ
b.	*Uneven trochee*	(× .)		(×)
		σ ⏑	*or*	σ

The empirical evidence against the feet of (2) is that rhythmically alternating patterns in stress languages seem not to require these. In

particular, no languages seem to impose an iambic rhythm on syllables regardless of their quantitative make-up (cf. (2a)), nor are any trochaic languages attested whose rhythmic patterns consistently group together a heavy syllable with a following light syllable in a rhythm unit (cf. (2b)). (Some languages that have been analysed by uneven trochees in previous literature are plausibly reanalysed as 'ternary' by Hayes: Old English in §5.4.4, and Bani-Hassan Arabic in §8.10.)

The status of the degenerate foot will be discussed in §2 below. Here I will concentrate on Hayes' explanation for why metrical theory should contain precisely the arbitrary collection of feet in (1), while excluding both the syllabic iamb (2a) and the uneven trochee (2b).

Hayes relates the asymmetric foot inventory to a perceptual universal that was discovered by psychologists (Bolton 1894; Woodrow 1909), and according to which the perceived rhythmic grouping of elements depends on the way the elements are differentiated, i.e. by intensity or by duration. More precisely, sequences of elements that alternate in duration tend to be perceived as iambic, while sequences of elements that alternate in intensity tend to be perceived as trochaic. Hayes (p. 80) states it as:

(3) *Iambic/Trochaic Law*

a. Elements contrasting in intensity naturally form groupings with initial prominence.

b. Elements contrasting in duration naturally form groupings with final prominence.

The Iambic/Trochaic Law is the 'extrasystemic motivation for internal principles of the linguistic system', that is, the new asymmetric foot inventory.

Let us find out to what extent the Iambic/Trochaic Law actually predicts these three feet and their different shapes. The first clause might be interpreted as predicting that languages that lack elements contrasting in duration (i.e. quantity-insensitive languages) should have trochaic rhythm. As Hayes shows, there is overwhelming evidence for this prediction – these of course are syllabic trochee languages. The second clause of the law predicts that if a language juxtaposes sequences of syllables of contrasting duration, then its feet should be iambic. Or when naively interpreted, quantity-sensitive languages should be iambic. This strong prediction of course fails for moraic trochee languages, to which quantity-sensitivity is essential. The general point seems to be that clause (2b) is to be interpreted slightly more weakly. Instead of taking 'elements of contrasting duration' as 'unevenness within a word', we should interpret it as 'unevenness *within a foot*'. This result is at odds with the fact that the perceptual evidence for the Iambic/Trochaic Law is based on long sequences of elements rather than on binary chunks.

Exactly which implications do hold between foot type, quantity-sensitivity and (un)evenness within the foot for the asymmetric inven-

tory? Below I have arranged all six logical possibilities that are consistent with the 'spirit' of the Iambic/Trochaic Law, and indicated their truth values in terms of the asymmetric foot inventory (I have stated logically equivalent implications in parentheses):

(4) a. i. *If iambic, then QS* (= *if QI, then trochaic*).
True: *(σ σ)
ii. If trochaic, then QI (= if QS, then iambic).
False: (⏑ ⏑)

b. i. *If trochaic, then even* (= *if uneven, then iambic*).
True: *(– ⏑)
ii. If iambic, then uneven (= if even, then trochaic).
False: (⏑ ⏑)

c. i. If QI, then even (= if uneven, then QS).
True: (trivially)
ii. If QS, then uneven (= if even, then QI).
False: (⏑ ⏑), (–)

Clearly, the implications stated as (4a.i, 4b.i) are the heart of the asymmetric inventory. They exclude the 'syllabic iamb' and the 'uneven trochee', respectively. The reverse of both implications does not hold, however. As observed above, the moraic trochee (⏑ ⏑) contradicts (4a.ii), showing non-equivalence of trochaicity and quantity-insensitivity. The heavy foot (–), which is quantity-sensitive yet not 'uneven', in contradiction to (4c.ii), simply reflects pure quantity-sensitivity, i.e. attraction of stress by a heavy syllable. Most against the spirit of the Iambic/Trochaic Law is the even iamb (⏑ ⏑), which contradicts (4b.ii). Although this foot is observable in many iambic languages, Hayes shows that it is often 'repaired' into a canonical uneven iamb (⏑ –), by a lengthening of the vowel in its strong syllable, or by a reduction of the vowel in the weak syllable. A mirror image of iambic lengthening occurs in trochaic languages, in the form of 'trochaic' shortening of a heavy syllable followed by an unparsed light syllable: (⏑) ⏑ → (⏑ ⏑). Here, trochaic rhythm is enhanced by 'balancing out' a quantitatively unbalanced sequence (cf. Prince 1992). Both iambic lengthening and trochaic shortening show that a language-particular choice of foot may have pervasive effects in the segmental phonology.

In conclusion, the Iambic/Trochaic Law can be said to motivate the asymmetric foot inventory to the extent that iambs are quantity-sensitive and trochees are 'even'. A provision must be made that 'elements contrasting in duration' refers to contrasts within the foot rather than within a longer domain (e.g. prosodic word). A second provision is the universal tolerance for monosyllabic heavy feet regardless of rhythmic type. Finally, the even iamb stands in severe violation of the Iambic/Trochaic Law, but there is good evidence that iambic languages actually avoid it by iambic lengthening.

2.1 The rhythmic structure of quantity-sensitive feet

As I have shown above, the Iambic/Trochaic Law partly motivates the asymmetric foot inventory, but does not fully *predict* it. The question then naturally arises of whether the inventory is a linguistic primitive, or whether independent linguistic principles derive it. An attempt has been made by Prince (1992) with respect to quantity-sensitive feet. The idea is that of 'harmony' defined as relative foot well-formedness on a scale. In essence, the HARMONY value of a foot is a function of the weight of its constituting syllables. The heavier the second syllable as compared to the first, the more harmonic is the foot.

(5) *Harmony ratings* (Prince 1992)

a. Iambic scale	(⏑ –)	>	(⏑ ⏑), (–)	>	(⏑)
	$H = 2$		$H = 1$		$H = 0$
b. Trochaic scale	(⏑ ⏑), (–)	>	(⏑ –)	>	(⏑)
	$H = 1$		$H = \frac{1}{2}$		$H = 0$

Under this approach, the uneven trochee is not absolutely ill-formed, but merely less well-formed than the even trochee. Degenerate feet come out as the least harmonic feet. I will return to this issue in §3. Although the Harmony function produces the relative well-formedness of feet, one could argue that it does not provide an explanation in terms of *independent rhythmic principles*. In fact it merely restates the observation.

An attempt at a deeper explanation is made by Kager (1993), who argues that the ill-formedness of the uneven trochee is grounded in two linguistic factors, sonority and lapse. First, the universally falling sonority profile of the bimoraic syllable makes it a strong–weak rhythm unit (Prince 1983). The heavy syllable may be considered to be the minimal *binary* rhythm unit, hence the minimal foot. Second, the rhythmic notion LAPSE is independently motivated in metrical grid theory (Prince 1983; Selkirk 1984) as a sequence of two weak grid elements. When this notion is relativised to the foot as its domain, and to the mora as a rhythm unit, this provides an explanation for the relative ill-formedness of the uneven trochee as compared to that of the uneven iamb. As shown below, the former, not the latter, contains a mora lapse within the foot.

(6) *Mora-rhythmic representations of quantitative feet* (Kager 1993)

Iambs		*Trochees*	
a. (⏑ –) = (. × .)		d. (⏑ ⏑) = (× .)	
b. (–) = (× .)		e. (–) = (× .)	
c. (⏑ ⏑) = (. ×)	*Final beat*	f. (– ⏑) = (× ..)	*Lapse*

Under this mora-rhythmic representation, what both 'least optimal' feet (6c, 6f) have in common is that they do not end in a strong–weak rhythmic profile at the moraic level. This matches a typologically common tendency for larger prosodic units (PrWd) to end in a strong–weak sequence (cf. the constraint NON-FINALITY in Prince & Smolensky 1993). Iambic length-

ening can now be interpreted as a means of lengthening the strong syllable in a foot (itself a natural process) without introducing a mora lapse, or alternatively, of bringing about a strong–weak profile at a foot's right edge. In contrast, lengthening the initial syllable of a trochee is much less attractive, as it would introduce a lapse, and is not required to bring about a strong–weak profile. Finally, trochaic shortening amounts to the elimination of a mora lapse.

The fact that the even iamb (⏑ ⏑) is attested, whereas the uneven trochee (– ⏑) is not, can be explained in terms of relative foot well-formedness (Prince 1992). In order to build a better iamb than the even iamb, a heavy syllable would be required in the immediate context (since both (6a) and (6b) contain heavy syllables). A heavy syllable may simply not be available in the context, and languages may not allow for the option of creating one by 'iambic lengthening'. But for the uneven trochee, an alternative parsing by more optimal feet is always possible: the one in which the heavy syllable is parsed as a foot on its own, cf. (–) (⏑ ⏑) (⏑ ⏑)... rather than (– ⏑) (⏑ ⏑) (⏑ ⏑)...

2.2 The status of quantity-disrespecting feet

The major remaining question is why the 'quantity-disrespecting' syllabic iamb (σ σ) is marginal at best, while its mirror image, the 'quantity-disrespecting' syllabic trochee, is empirically attested. In fact, the distinction may be weaker than Hayes assumes, since it turns out that quantity-disrespecting trochaic rhythm is never attested in its pure form. I will argue that syllabic trochaic rhythm is in fact limited to a small number of languages that show independent evidence for two factors, initial syllable 'top-down' stressing and clash avoidance. Then I argue that these factors, when imposed on an iambic language, would in fact obliterate iambic rhythm. The conclusion will be that the lack of quantity-disrespecting iambic languages may be explained without the Iambic/Trochaic Law.

In Kager (1992) I argued that no trochaic language completely disrespects a quantity distinction. This is confirmed by the 'quantity-disrespecting' syllabic trochee languages which Hayes mentions on p. 102, i.e. Anguthimri, Chimalapa Zoque, Czech, Hungarian, Estonian, Finnish, Mansi, Pintupi, Piro and Votic. First, as Hayes points out, 'syllabic trochee languages characteristically employ a minimal word constraint of the form /–/'. Actually, this is the basis for his claim (§5.1.9) that the degenerate foot is universally defined as a monomoraic foot – that is, including syllabic trochee languages. Second, Estonian and Finnish have various phonological and morphological processes (gradation, etc.) that refer to syllable quantity and quantitative feet (Prince 1980; Keyser & Kiparsky 1984). To label these languages as 'quantity-disrespecting' would amount to a denial of their quantity-based phonologies. Third, some languages have a restriction that long vowels must occur in stressable syllables (as in Anguthimri) or in the main-stressed (initial!)

syllable (as in Pintupi, Mansi and Votic). Fourth, Estonian, Finnish, Hungarian and Czech display preferences for heavy syllables to occupy rhythmically strong positions in optionally binary/ternary rhythmic patterns. Fifth, Estonian, Finnish and Chimalapa Zoque allow monosyllabic heavy feet in weak peripheral positions.

(7)

Language	*Rhythmic pattern*	*Min*	*Quantity distinction*
Pintupi	100, 1020, 10200, 102020	2μ	Only in initial syllables
Anguthimri	100, 1010	2μ	Only in stressable syllables
Mansi, Votic	100, 1020, 10200, 102020	2μ	Mostly in initial syllables
Estonian	100, 1020, 10200/10020	2μ	Free, with final (-) allowed
Finnish	100, 1020, 10200/10020	2μ	Free, with final (-) allowed
Czech	102, 1020, 10202/10020	None	Free, partly QS (Jakobson)
Hungarian	102, 1020, 10202/10020	None	Free, partly QS (Kerek)
Piro	010, 2010, 20010, 202010	None	Mostly in stressed syllables
Chimalapa Zoque	210, 2010, 20010, 200010	2μ	Free, stress non-iterative

A generalisation that emerges immediately is that all languages in (7) except Chimalapa Zoque and Piro have initial main stress. However, Chimalapa Zoque has initial syllable secondary stress, and for this reason fails to motivate the syllabic trochee as an iterative foot. Piro has been argued by Yip (1992) not to have heavy syllables in weak positions. The second generalisation is that all languages except Chimalapa Zoque have avoidance of clash: monosyllabic feet (which must be heavy in Finnish and Estonian) occur at the end of the word only. These two properties might be analysed by TOP-DOWN STRESSING, a mechanism that is independently required in moraic trochee languages (van der Hulst 1984; Hayes 1995). The 'top-down' strength of the initial syllable, by clash avoidance, precludes secondary stress on the second syllable. (Interestingly, Cahuilla, a top-down moraic trochee language analysed in §6.1.3, shows clash avoidance in the same context, albeit optionally.) All this means that iterative footing could still be due to the moraic trochee (hence the bimoraic word minimum) plus clash avoidance under foot parsing (see Kager 1993 for an analysis along these lines).

Then the original question, of why 'quantity-disrespecting' iambic languages do not occur alongside 'syllabic trochee' languages, may be rephrased as follows: why are there no iambic languages that have 'top-down' stressing in combination with syllable clash avoidance? First, the absence of iambic top-down stressing follows from the fact that top-down stressing inherently promotes a peripheral syllable (typically, the initial

syllable). Since iambic rhythm is signalled mainly by *second syllable* stress, 'top-down stressing' would simply destroy the iambic pattern. Second, there is actual evidence for syllabic (clash-avoiding) rhythm in iambic languages. A suitable example is Menomini, which according to Bloomfield (1962) has the following stress pattern:

(8) Primary stress ... comes on every long vowel or diphthong that is in the next-to-last syllable of a word or compound-member:
  a. enɛ́·niw 'man'
  b. sé·pe·w 'river'
  A primary stress comes also on every long vowel or diphthong that is followed, in the same word or compound-member, by a syllable containing a short vowel:
  c. mé·wenɛ̀sehɛ̀wak 'they drive him away'
  d. kayé·wanɛmá·cenen 'whenever he speaks ill of him'
  Secondary stresses ... come generally in the even-numbered (second, fourth, etc.) vowels in a succession of syllables, but not on a syllable in word-final position:
  e. kɛhkèmen new 'luckily indeed'
  f. mé·wenɛ̀sehɛ̀wak 'they drive him away'
  g. nepí·htikɛ̀menaw 'we enter'
  h. netà·ka·wà·tá·nan 'I hanker for them'

Hayes discusses Menomini in §6.3.4, and shows that the language must be iambic, since it has two rules that lengthen the head of a disyllabic iambic foot. He does not discuss the stress pattern in detail, however. The interesting fact to note is that heavy syllables are not automatically stressed, but that their stress values depend on rhythmic factors. Notice especially the lack of stress on a heavy syllable that is between two other heavy syllables, cf. (8h).

Another iambic language that avoids adjacent stressed syllables is Sierra Miwok (Freeland 1951; Broadbent 1964). Primary stress falls on the first syllable if it is heavy, otherwise on the second syllable. Secondary stress tends to fall on the final syllable, but when the preceding syllable has primary stress, the final syllable remains unstressed (all examples below are from the Central dialect; Freeland 1951: 7):

(9) a. húʃʃe·pìʔ 'water spirit'
  b. tákkawwàʔ 'ground squirrel'
  c. paláṭṭaṭàʔ 'woodpecker'
  d. tayíʃmuʔ 'jay'
  e. pulíssaʔ 'drinking basket'

As Hayes mentions on pp. 250–251, there is additional evidence for clash avoidance from the Southern dialect of Sierra Miwok. Broadbent (1964: 17) reports: 'Secondary stress falls on succeeding long syllables. In a long sequence of long syllables, the even-numbered ones tend to be less heavily stressed than the odd-numbered ones, counting from the beginning of the

long-syllable sequence.' (Unfortunately, Broadbent provides no examples.) A similar clash-avoiding pattern in General Central Yupik is discussed by Hayes in §6.3.8.3. The similarity with clash-avoiding patterns of trochaic languages such as Finnish and Estonian is clear.

The important point is that Menomini, Sierra Miwok and General Central Yupik all have rhythms that, to some extent, avoid adjacent stresses, and allow heavy syllables to be unstressed in order to achieve this goal. If these patterns are analysed as footing + iterative-destressing (as Hayes proposes on p. 251), the 'syllabic trochee' patterns of the languages in (7) might be analysed likewise. This outcome weakens the case for quantity-disregarding 'syllabic trochees', and also casts doubts on the strong typological distinction between trochaic and iambic rhythm that Hayes assumes.

3 Degenerate feet

The second main proposal of the book, closely related to the asymmetric foot inventory, is a restriction on 'degenerate feet'. It is outlined in §5.1. Degenerate feet are the logically smallest possible feet. They consist of a single light syllable (or of a single syllable in a language that has no distinction of weight). According to earlier versions of metrical theory (Hayes 1980; Halle & Vergnaud 1987), a single light syllable that could not be parsed in a binary foot automatically formed a degenerate foot. It was later pointed out by McCarthy & Prince (1986), Hayes (1987), Kager (1989) and others that languages tend to avoid degenerate feet in various ways. In the strongest case, degenerate feet are completely disallowed, as can be inferred from the minimal word size in languages such as Diyari and Latin, in which the minimal word equals a binary foot (of two syllables or two moras). Minimal words may be enforced by vowel lengthening, epenthesis, etc. However, degenerate feet cannot be ruled out universally, since languages such as Cahuilla and Maranungku allow for degenerate-size words. To account for this typology, Hayes (p. 87) proposes a binary parameter:

(10) *Prohibition on degenerate feet*

Foot parsing may form degenerate feet under the following conditions:

a. *Strong prohibition* absolutely disallowed.

b. *Weak prohibition* allowed only in strong position, i.e. when dominated by another grid mark.

Universally degenerate feet remain in place until the point in the derivation at which the End Rule applies. In a weak-prohibition language, a degenerate foot may be promoted by the End Rule if it stands in the proper (rightmost or leftmost) position. Degenerate feet are deleted regardless of metrical strength in a strong-prohibition language. Hayes

leaves open the option that degenerate feet are repaired before falling victim to deletion, for example by vowel lengthening or a reparsing of foot boundaries. This theory makes three predictions, which I will discuss in consecutive sections below. First, universally degenerate feet do not occur in weak positions at the surface, irrespective of whether a language has degenerate-size words or not. Second, weak-prohibition languages (which tolerate degenerate-size words) may have degenerate feet in strong metrical positions in polysyllabic words as well. Third, lengthening or reparsing of foot boundaries may take place in positions that correspond to those where degenerate feet are initially assigned.

3.1 Degenerate feet in weak positions

I first discuss the issue of degenerate feet in weak positions, which Hayes addresses in §5.1.8. A standard argument for degenerate feet in earlier theories is that languages with rightward trochees (and initial main stress) may have final secondary stresses in words that cannot be parsed exhaustively by binary feet. Consider an example of this, Cahuilla, a moraic trochee languages (§6.1.3):

(11)	a.	i.	(⏑ ⏑)⏑	táxmuʔàt	'song'
		ii.	(–)⏑	páʔlì	'the water (OBJ)'
	b.	i.	(⏑ ⏑)(⏑ ⏑)	tákalìčem	'one-eyed ones'
		ii.	(–)(⏑ ⏑)	qá:nkìčem	'palo verde (PL)'

Hayes argues that the reported final secondary stresses in words such as (11a) do not reflect degenerate feet. Instead, weak final beats are perceptual effects of phonetic final lengthening, which may easily be confused with final stress. He gives arguments for the non-phonological nature of such final secondary stresses in his analysis of Icelandic, to which I return below.

However, there are various problems with this proposal. First, why should the perception of final weak stresses be sensitive to syllable counting? Hayes points out (on p. 100) that 'final lengthening would also affect posttonic final syllables, but given an otherwise alternating pattern, there would be no a priori tendency to hear stress in such cases'. Perception is 'biased' by syllabic rhythm, so to speak. If this explanation holds, then perception should be biased by *moraic* rhythm as well, as example (11a.ii) from Cahuilla shows. This should not be possible if the syllable is the unit of stress, as Hayes claims it is. In Cahuilla, the mora-based contrast between stressed and unstressed final syllables even arises in the context of an immediately preceding stress. This contrast is most apparent in minimal pairs that are due to morphologically triggered gemination of the coda consonant of the first syllable, e.g. *wél.net* 'mean one' (two light syllables are grouped in a moraic trochee) *vs. wéll.nèt* 'very mean one' (a heavy foot is followed by an unfooted light syllable).

A second problem to a phonetic lengthening account of final weak beats is that it fails to explain why some languages have it, while others do not.

It has been pointed out by both Kiparsky (1991) and Kager (1995b) that in rightward trochaic systems, the presence of degenerate-size words correlates with the presence of final stresses in odd-numbered words. This correlation cannot be captured in Hayes' theory, in which final stresses are due to a phonetic factor, and hence are not under grammatical control. Kiparsky accounts for this correlation by eliminating degenerate feet universally, and attributing final beats to the language-specific option of CATALEXIS. Catalexis is a segmentally empty metrical position at the right edge of the word, i.e. essentially the logical counterpart of extrametricality. (For similar proposals, see Giegerich 1985 and Burzio 1988). In languages that select catalexis, like Cahuilla, it occupies the weak position in a binary foot:

(12)	a.	i.	(∪ ∪)(∪ [×])	táxmuʔàt
		ii.	(–)(∪ [×])	páʔlì
	b.	i.	(∪ ∪)(∪ ∪)[×]	tákalìčem
		ii.	(–)(∪ ∪)[×]	qá:nkìčem

The catalectic position has effects on footing only in words with an odd number of moras. It remains unfooted, hence prosodically inert, in words with an even number of moras. It is correctly predicted that catalectic languages have no word minimum. This is because a binary foot can be built over a monomoraic word plus a catalectic position.

The correlation between degenerate-size words and weak final beats holds in the following way for the rightward trochaic languages that Hayes discusses in the book (I include only languages for which Hayes provides information on both degenerate-size words and final beats):

(13) *Correlation between degenerate-size words and stresses on odd final syllables*

a. Degenerate-size words, stresses on odd final syllables: Cahuilla (§6.1.3), Auca (§6.2.1), Czech, Dehu, Livonian, Maranungku, Ono, Selepet (all in §6.2.3), Hungarian (§8.6).
b. Degenerate-size words, no stresses on final syllables: *none*.
c. No degenerate-size words, stresses on odd final syllables: Icelandic (§6.2.2), Mansi, Votic, Wangkumara (all in §6.2.3).
d. No degenerate-size words, no stresses on final syllables: Cairene Arabic (§4.1.3), Old English (§5.4.4), Palestinian Arabic (§6.1.1), Anguthimri, Badimaya, Bidyara/Gungabula, Dalabon, Diyari, Mansi, Mayi, Pitta-Pitta (all in §6.2.3), Egyptian Radio Arabic (§6.1.2), Estonian (§8.5), Finnish (§8.6), Mantjiltjara (§8.10).

This result strongly confirms the typological findings of Kiparsky (1991) and Kager (1995b). The only languages that seem to break the correlation are those of (13c). In Mansi, sources differ as to whether odd final syllables are stressed. Presence of final beats in Votic and Wangkumara seem to depend on level-ordered phonologies in which catalexis is switched 'on'

or 'off' at different levels (Kager 1995b). In itself this forms evidence for the claim that final beats are under grammatical control. In Votic (Kiparsky 1991), final beats are restricted to a morphologically defined class, i.e. to words that contain no case affixes. For Icelandic, an account will be presented below.

Let us now discuss Hayes' arguments against the foot status of weak degenerate feet in Icelandic. Essentially, this argument is based on the partial preservation of word-level secondary stress under compounding. Main stress is initial, with secondary stress on alternating syllables thereafter (i.e. rightward trochees and End Rule Left). The final syllable of words of three or five syllables is reported to have a secondary stress, e.g. *'höfðing,ja* 'chieftain (GEN PL)', *'bío,grafí,a* 'biography'. (Icelandic orthography indicates vowel quality by accent marks.) Hayes argues that these final stresses are due to phonetic final lengthening. In compounds, when stresses of constituting words are in a situation of stress clash, a destressing takes place at all levels of the grid. Feet that are not in a clash are preserved. Compare (14a), where the secondary stress on the third syllable of *'krambú,leruð* is preserved in compound. Destressing is followed by 'persistent footing', which reparses syllables left stray by defooting, as shown in (14b.i).

```
(14)  Word-level          Destressing          Persistent footing
a.    (×            )     (×)                  (×            )   Cpd
      (×)  (×       )     (×)                  (×            )   Wd
      (×)  (×    .)(× .)  (×)        (× .)     (×    .)   (× .)   Foot
      ó#krambú l eruð     ó#krambúleruð        'ó#krambú,leruð

b. i. (×            )     (×)                  (×            )   Cpd
      (×)  (×       )     (×)                  (×            )   Wd
      (×)  (×    .)       (×)                  (×    .) (× .)     Foot
      stress#töskuna      stress#töskuna       'stress#tös,kuna

b. ii. (×           )     (×)                  (×            )   Cpd
      (×)  (×       )     (×)                  (×            )   Wd
      (×)  (×    .)(×)    (×)        (×)       (×    .)   (×)     Foot
      stress#töskuna      stress#töskuna     * 'stress#tösku,na
```

Hayes' argument against degenerate feet runs as follows. While the secondary stress on the penult in the righthand member in (14a) is preserved, the final secondary stress in (14b.i) does not surface. This demonstrates that there is no foot on the final syllable of *'tösku,na* in the input. If there had been a degenerate foot, as in (14b.ii), then it would have been respected by persistent footing, yielding an incorrect output **'stress# tösku,na*. The argument that the metrical inputs of compounding have no weak degenerate feet is solid, and I do not question it. However, an alternative account of final secondary stress is possible, one which does not

rely on phonetic lengthening. In Hayes' analysis, metrical structure is assigned in two steps, which correspond to the word and compound level. If we assume that these steps correspond to ordered levels in Lexical Phonology, then the assignment of final secondary stresses could be restricted to compound level. In terms of catalexis theory, this option is switched 'off' at word level, but can be switched 'on' at compound level. This makes the correct prediction that the minimal word is bimoraic, since there is no catalexis at word level, where minimal word size is checked. Kiparsky (1991) argues for a similar analysis of Votic, a language that restricts final secondaries to stem syllables, and has no final stresses on case affixes. Here catalexis is switched 'off' at the word level.

3.2 Degenerate feet in strong metrical positions

The second empirical prediction made by Hayes' theory of degenerate feet is that in 'weak-prohibition' languages, degenerate feet may occur in strong metrical positions in polysyllabic words. We will see below that this prediction is confirmed, even though a restriction is imposed by Hayes on the assignment of degenerate feet, due to which such a foot may not be assigned in a position where it would otherwise acquire main stress. This is the Priority Clause (Hayes p. 95):

(15) *Priority Clause*

If at any stage in foot parsing the portion of the string being scanned would yield a degenerate foot, the parse scans further along the string to construct a proper foot where possible.

Its purpose is to block the assignment of a degenerate foot in the beginning of the foot parse, since that would otherwise be promoted to main stress. For example, degenerate feet must not be formed in initial position in Malayalam (16a), which has End Rule L, nor in final position in Spanish (16b), which has End Rule R:

```
(16) a.   (×)          (×  )   b. (×  )          (  ×)
          (×)          (×)(×)     (×)            (×)(×)
       # ◡ –    not  * # ◡ –       – ◡ #    not  *  – ◡ #
```

The Priority Clause thus restricts strong degenerate feet to the edge that is opposite to the one at which foot parsing starts. In the book I have found only one weak-prohibition language that actually uses this option in polysyllabic words. Auca (§6.2.1) promotes to main stress the rightmost trochee of a rightward parse, regardless of whether it is binary or degenerate. In itself, this small number is not totally unexpected, given the strong cross-linguistic tendency to place main stress at the edge where foot parsing starts (Hammond 1984; van der Hulst 1984). Analogously, only a few strong-prohibition languages promote a foot at the opposite edge: Cairene Arabic (§4.1.3), Creek/Seminole (§4.1.2), Wargamay (§6.1.4) and Asheninca (§7.1.8). The Priority Clause thus narrows down

the range of potential cases that bear on the prediction of strong degenerate feet in polysyllabic words. On the basis of Auca alone, one might consider the prediction of strong degenerate feet in polysyllabic words to be falsified.

However, Auca is not the only weak-prohibition language in the book that has strong degenerate feet in polysyllabic words. A second source is a size reduction of the domain by a rule of (syllable or foot) extrametricality, in which case a degenerate foot is built on the only stressable syllable, cf. (17b), as in Hindi (§6.1.7), Klamath (§7.1.4), Asheninca (§7.1.8) and Cayuvava (§8.2.1). Some of these languages actually repair a strong degenerate foot at the surface, by incorporation of the extrametrical syllable (see §3.3 below). The third, by far most productive, source of strong degenerate feet is 'top-down' stressing (17c), the construction of the word layer prior to footing. Top-down stressing places main stress on the initial or final syllable irrespective of its weight. It serves to fix main stress in contexts similar to (16), which would otherwise violate the Priority Clause, because the degenerate foot may stand at the edge where footing starts. This promotes a degenerate foot on the initial syllable in Old English (§5.4.4), Cahuilla (§6.1.3), Tümpisa Shoshone (§6.1.9) and Mayi (§6.2.3), and a degenerate foot on the final syllable in Tübatulabal (§6.3.10) and Cayuvava imperatives (§8.2.1). Again, one of these languages (Old English) 'repairs' the degenerate foot by an incorporation of the following syllable. We thus find three types of strong degenerate feet in long words:

(17) a. At an edge opposite to that where foot construction starts; e.g. Auca:

```
(          ×)
(×  .)(×  .)(×)        e.g. tíkawódǫ**no** (kąba) '(he) lights'
 σ  σ  σ  σ  σ
```

b. On the only available syllable after extrametricality; e.g. Hindi:

```
(×)
(×)⟨(×)⟩               e.g. **ká**la: 'art'
 ◡   –
```

c. On an edge syllable by top-down stressing; e.g. Cahuilla:

```
(×     )
(×)(×)                 e.g. **sú**kàʔtì 'the deer (OBJ)'
 ◡  –  ◡
```

What (17b) and (17c) have in common is the forced character of the degenerate foot, as the single way of satisfying 'top-down' requirements. (Culminativity, i.e. the pressure to assign a foot to some syllable in the domain, cf. (17b), is clearly a top-down effect.) It would be a welcome

strengthening of the theory to restrict degenerate feet to contexts where top-down requirements enforce them (cf. Kager 1989: 143). An immediate bonus of this would be the elimination of the Priority Clause, which becomes a specific case of a more general prohibition on degenerate feet. The language instantiating (17c), Auca, provides evidence against such a theory. Here the promotion of a degenerate foot cannot be due to top-down stressing, since the location of the main stress depends on rightward footing, and is not uniformly final. Hayes argues convincingly that there is a degenerate foot on the final syllable of (17a). In contrast to the situation in Icelandic, the degenerate foot on a stem syllable is respected by footing in a larger lexical domain, one which includes suffixes.

An evaluation of Hayes' proposal that degenerate feet may be assigned freely, and are consequently deleted in weak positions, thus largely depends on the value of the analysis of Auca. This analysis is not entirely unproblematic, since Pike (1964) reports that all stresses are equally strong. Therefore the degenerate foot that is supposedly in a 'strong' position is perceptually as weak as any other foot. Hayes provides an analysis of Auca intonation that is intended to support his claim the rightmost foot is strong, a review of which would take us too far. However, as he admits in a footnote on p. 184, a second source on Auca does not confirm the main stress status of stem-final feet. I conclude that Hayes' theory of degenerate feet may be subject to strengthening in ways I outlined above. However, a final judgement will depend on the strength of arguments from Auca, and possibly from other languages.

3.3 Repair of degenerate feet

As we saw earlier, Hayes proposes that degenerate feet are universally generated (under the restriction of the Priority Clause), and are preserved up to the point in the derivation where the End Rule applies. At this point weak degenerate feet are deleted universally, while strong-prohibition languages delete all degenerate feet. However, in §5.1.7 Hayes argues for language-specific alternatives to deletion of degenerate feet, in the form of repair. Degenerate feet may be repaired in various ways, e.g. by vowel lengthening, or by reparsing of foot boundaries. Under this scenario, repair 'bleeds' deletion. This is fully compatible with the general idea that weak/strong prohibitions on degenerate feet are checked in the *output*, rather than in foot parsing. Constraints on well-formedness of outputs form in fact the cornerstone of Optimality Theory (Prince & Smolensky 1993).

An example of a repair of a degenerate foot by vowel lengthening is found in Chimalapa Zoque (§5.1.9). It has penultimate main stress, and initial secondary stress. The initial secondary stress is derived by End Rule Left, producing an unbounded left-headed foot at the left edge. In trisyllabic words, there is only one 'free' syllable before the main stress trochee. In this context, the degenerate foot is repaired by vowel lengthening, e.g. [pàːtáːnus] 'large cooking banana'.

An example of a repair by reparsing foot boundaries is the INITIAL DACTYL EFFECT, which occurs in various languages. Spanish has lexical main stress, and secondary stress feet are assigned from right to left. If the main stress is preceded by a sequence of an odd number of syllables, the initial syllable has secondary stress, while both the second and third syllable are unstressed (hence the term 'initial dactyl'). This is analysed as a repair of the initial degenerate foot. The clash between the first two syllables triggers a destressing of the second syllable, which is followed by a reparsing of foot boundaries:

(18)
```
(                   ×   )        (                   ×   )
(×) (×  .)(×  .)(×  .)(×   .)    (×   .)  (×  .)(×  .)(×   .)
 σ   σ  σ σ  σ σ σ σ   σ    →    σ   σ  σ σ  σ σ σ σ   σ
Constantinopolitanismo           Còǹstantinòpolìtanísmo
```

Notice that in the output representation, there are no weak degenerate feet, although the initial degenerate foot was essential in creating the clash that triggers reparsing.

An important question is whether this type of analysis does not open Pandora's box. 'Abstract' degenerate feet at intermediary levels of derivation may, in principle at least, induce patterns that are never attested in any natural language. For example, by a language-specific rule ordering, a destressing rule would apply before the End Rule, so as to eliminate the binary foot on which the main stress would otherwise be seated. For example, it is entirely possible to derive an initial dactyl pattern such as that of Spanish, but with the difference that it would include the main stress in three-syllable words, e.g.:

(19)
```
                          (×     )
(×)(×  .)     (×  .)      (×  .)
 σ  σ  σ  →    σ  σ  σ  →   σ  σ  σ
```

Bleeding the End Rule, destressing disturbs the fixed pre-final stress pattern by deriving penultimate stress in trisyllabic words. As far as I know, such languages are universally unattested. (Interestingly, the closest analogue is Manam, discussed briefly by Hayes in §6.1.9. Main stress falls on the rightmost moraic trochee, but words of the shape /– ∪ ∪/ have antepenultimate stress. Hayes proposes 'a rule of extrametricality in clash or equivalent', but fails to mention that this would also generate antepenultimate stress in words of the shape /∪ ∪ ∪/.)

Even when respecting a universal ordering of the End Rule prior to destressing, unattested patterns may arise. Here is an example. The stress pattern of Garawa (p. 202) is analysed by Hayes by (i) a non-iterative assignment of an initial trochee, (ii) iterative assignment of trochees from right to left and (iii) End Rule Left. Garawa respects the universal ban on weak degenerate feet by deletion, as in (19a). This produces a pattern 100202020. Crucially, a degenerate foot on the third syllable is predicted

by the Priority Clause. At 'the stage in foot parsing' at which it is assigned, the initial foot has already been assigned. Arguably 'the portion of the string being scanned' is then restricted to the syllables that are still unfooted (cf. p. 99). The medial degenerate foot thus stands at the end of the portion of the relevant string, in conformity with the Priority Clause:

```
(20) a. (×                    )     (×                    )
        (× .)(×)(× .)(× .)(× .)     (× .)  (× .)(× .)(× .)
         σ σ σ σ σ σ σ σ σ  →        σ σ σ σ σ σ σ σ σ

     b. (×                    )     (×                    )
        (× .)(×)(× .)(× .)(× .)     (× .)(× .)  (× .)(× .)
         σ σ σ σ σ σ σ σ σ  →        σ σ σ σ σ σ σ σ σ
```

Now assume that another language had this set of rules, but in addition a rule of destressing as in Spanish. This would produce a 'second position dactyl' effect, with the pattern 102002020, as in (20b). This pattern is universally unattested, as far as I know. As an improvement over Hayes' theory, one might modify the Priority Clause such that it excludes the assignment of degenerate feet in medial positions, thus excluding (20b) in a principled way. (On p. 99 Hayes comes close to such a step in observing that medial degenerate feet never trigger repairs.) Still, a stronger generalisation is possible, which includes all cases of repair, both vowel lengthening and reparsing of foot boundaries, in the book. That is, repair aims at a 'proper' foot at the edge of a domain. In Optimality Theory, this effect is known as alignment (McCarthy & Prince 1993). Importantly, such an analysis does not involve degenerate feet in intermediary stages of the derivation.

To sum up, degenerate feet in intermediary stages of derivations are motivated to the extent that these trigger vowel lengthenings and foot reparsings that are otherwise difficult to explain. But the role of 'abstract' degenerate feet should be sharply limited, perhaps by a universal ordering of the End Rule prior to destressing, as well as by some 'peripherality'-based reformulation of the Priority Clause.

4 A review of the chapters

Below I will discuss the remaining contents of the book in a chapter-wise fashion.

Chapter 2 ('Diagnosing stress patterns') starts by defining stress as the linguistic manifestation of rhythmic structure, a view that is at the heart of metrical phonology. From this definition it follows that phonetically, stress can be manifested in a variety of ways, both among languages and within a single language. As an illustration, Hayes then sums up the various phonetic diagnostics for English, arguing for at least four levels of stress. Only primary stressed syllables may attract nuclear intonational tones. Stressless syllables are diagnosed by the quality of their vowels

(schwa and other reduced vowels like [m̩] and [n̩]), and by segmental rules (Flapping, Medial Aspiration, /t/-insertion, /l/-devoicing). Some dialects have a finer distinction among secondary stressed syllables that is diagnosed by intonation patterns. In a word that has multiple stresses before the primary stress, a non-nuclear tone is attracted by the strongest (e.g. ***Còn**stàntin**óple** vs. tòtàlitárian*). This distinction is further supported by the 'Rhythm Rule', which retracts the primary stress in the first word to its strongest secondary stress (e.g. ***Còn**stantinople tráins vs. totàlitarian **tén**dencies*). At the end of the chapter Hayes discusses the issue of whether there is a theoretical upper limit to the number of stress levels, an issue that has been hotly debated in the phonetic and phonological literature. His conclusion is that no such upper limit should be assumed, and that the realisation of stress levels depends on the language-particular means of realising stress: 'the data rather suggest that the phonology can create an unbounded number of levels, and that these gradually blur out as they increase in number and the phonetic cues signal them with progressively less clarity'. Of course, the relative abstractness of stress (a kind of rhythmic organisation), together with its highly variable phonetic cues, raises the important question of how to interpret reported data from secondary sources, which often depend solely on auditory impressions. Hayes comforts the reader by arguing that a high degree of intersubject agreement is reported in perceptual studies. Finally, he argues that 'by intensive study of the intonational and segmental phonology of a language, it is possible to make the investigation of stress patterns more rigorous'.

Chapter 3 ('Background') provides a highly useful overview of metrical theory, and of the standard empirical evidence for its major representational devices. It starts by introducing the typological properties of stress (i.e. culminativity, rhythmic distribution, stress hierarchies and lack of assimilation) by means of theory-neutral observations, and goes on to show how the linguistic formalism expresses these properties. Following Hammond (1984), Halle & Vergnaud (1987), etc., Hayes adopts the 'bracketed grid', a representational device that combines elements of RHYTHM (in the form of hierarchically layered grid marks) and CONSTITUENCY (in the form of bracketing). The terminal string of the bracketed grid consists of syllables, hence the prediction that a heavy syllable may not be split between feet (FOOT INTEGRITY; Prince 1980). This is controversial, in the light of Halle & Vergnaud's (1987) claim that the terminal string consists of line-0 grid marks, entities which roughly correspond to moras. Under their theory, both moras of a heavy syllable may belong to different feet, while one mora of a heavy syllable may be extrametrical. Two languages that are potential counterexamples to Foot Integrity (and potential evidence for Halle & Vergnaud's claim) are convincingly analysed as actually respecting it in §5.6.2 on Southern Paiute and §8.9 on Winnebago.

Two major constraints on metrical representations are introduced in this chapter. The CONTINUOUS COLUMN CONSTRAINT rules out gaps in grid

columns (cf. Prince 1983), thus securing proper landing sites for both the End Rule and stress shifts, while blocking deletions of feet supporting higher-level metrical structure. The FAITHFULNESS CONDITION (cf. Halle & Vergnaud 1987) guarantees a one-to-one relationship between heads and domains. It is motivated in a non-trivial way by the analysis of phrasal rhythm in Chapter 9.

Chapter 4 ('Foot inventory') lays out the heart of the theory, the asymmetric foot inventory, which I have already discussed in some detail in §2. Chapter 5 ('Further elements of the theory') outlines aspects of the theory that are less closely related to the asymmetric foot typology. I have already discussed the status of degenerate feet in §2. Here I concentrate on some other interesting points made in this chapter.

With respect to extrametricality, Hayes makes some interesting new proposals in §5.2. First, he argues that feet may be extrametrical in their entirety. A diagnostic for foot extrametricality is that main stress falls on a syllable that corresponds with the head of a second-to-last foot. (This may actually be the fourth syllable from the end of the word in languages such as Palestinian Arabic and Hindi; see comments on chapter 6 below.) This idea has been elaborated in Prince & Smolensky's (1993) analysis of Latin stress and shortening. An extension of the notion of foot extrametricality is that it may be triggered by clash, as motivated by Maithili (§6.1.6) and other languages.

Second, Hayes proposes to refine the interaction between syllabification and the Peripherality Condition. His proposal is that extrametrical higher-level constituents may dominate extrametrical lower-level constituents. The function of this is to allow the cooccurrence of consonant and foot extrametricality in Palestinian Arabic (§6.1.1) and in other languages. EXTRAMETRICAL consonants are those that are in canonical syllables (e.g. CV*C*# in Arabic). These are invisible to stress, although syllabified. A syllable that contains an extrametrical consonant may itself be extrametrical, or be part of a foot that is extrametrical in its entirety. In contrast, UNSYLLABIFIED consonants cannot syllabify into a canonical syllable (e.g. CVV*C*# or CVC*C*# in Arabic). Since these consonants are not part of higher-level prosodic structure, they block extrametricality of preceding feet or syllables, by the Peripherality Condition. The motivation for this is that words ending in CVC*C*# or CVV*C*# have final stress by End Rule Right (21b), while other words undergo the rule of foot extrametricality (21a):

(21) a. (ʕál).⟨(la.ma⟨t⟩)⟩ 'she taught' b. (duk).(ká:)⟨n⟩ 'shop'

The prediction is that extrasyllabic consonants *universally* block extrametricality of the preceding syllable. Footnote 5 on p. 108 admits that this is problematic because of the patterns of Latin and English, where syllable extrametricality seems not to be blocked by extrasyllabic consonants (cf. Eng. *gálaxy* /gælVksy/, Lat. *múltiplex*). Another problem is that extrametrical consonants (CV*C*), although syllabified, must be crucially invisible to Weight-by-Position, which is arguably a rule of

syllabification. It might be worth considering some reinterpretation of consonant 'extrametricality' as a constraint against heavy syllables in final position. This would unify it with the cross-linguistic tendency against final vowel lengthening in iambic languages (cf. p. 269).

Finally, Hayes argues against STRAY ADJUNCTION. The empirical motivation is that stray syllables block extrametricality of preceding syllables or feet, by the Peripherality Condition. Non-adjunction is crucial in Hayes' argument against the uneven trochee in languages with foot extrametricality, such as Palestinian Arabic and Maithili (see the comments on chapter 6 below).

§5.3 discusses various strategies that different languages use to deal with 'unstressable words'. These are disyllabic words whose final syllable is extrametrical, and whose initial syllable is light, and would have to form a degenerate foot on its own. Hayes observes that such words fall victim to conflicting requirements, i.e. the shape input of the word, foot well-formedness, extrametricality and culminativity. Hopi, an iambic language, sacrifices extrametricality and foot well-formedness by incorporating the extrametrical syllable as a weak syllable in a trochaic foot, e.g. (*kó*)⟨*ho*⟩ → (*kóho*). Latin sacrifices both extrametricality and the quantitative input shape, but preserves the bimoraic trochee, by shortening the second syllable, e.g. (*é*)⟨*go:*⟩ → (*égo*). Hixkaryana gives up quantitative input shape, rather than extrametricality or binary foot shape, by lengthening the first syllable, e.g. (*kwá*)⟨*ya*⟩ → (*kwá:*)⟨*ya*⟩. English uses a number of strategies, one of which is revoking extrametricality, e.g. *po*(*líce*). Finally, Sierra Miwok flatly gives up culminativity, so that /⏑ –/ words contain no primary stressed syllable at all. This typology of repairs has inspired analyses in Optimality Theory, a theory based entirely on resolution of conflicting constraints (Prince & Smolensky 1993).

In §5.4, Hayes discusses various modes of parsing. He introduces the notion of 'persistent stressing', by analogy to persistent rules in other phonological domains, such as syllabification. Languages may automatically reapply foot construction whenever its structural condition is met. For example, persistent footing repairs ill-formed metrical structure whenever segmental rules produce this, or resubmits stray syllables to proper foot construction, which may occur after a foot is deleted. In §5.6 Hayes argues that the weight of CVC syllables may vary from one context to another within a single language.

Chapter 6 ('Case studies') provides thorough analyses of a considerable number of languages, a detailed review of which would take too much space. On the whole, the depth of analysis is exemplary, and Hayes carefully points out the various implications of the analyses to metrical theory.

§6.1 gives detailed analyses of eight moraic trochee systems (Palestinian Arabic, Egyptian Radio Arabic, Cahuilla, Wargamay, Fijian, Maithili, Hindi, Lenakel), and brief analyses of some others. Four of these have foot extrametricality. Palestinian Arabic (§6.1.1) has rightward moraic trochees, with the rightmost foot extrametrical if it is strictly word-final.

End Rule Right applies to the visible feet, and thus derives main stress on the fourth syllable from the edge in (22b.i):

(22)	a. i.	(ká.ta).bu		'they wrote'
	ii.	(ša.ǰa).(rá.tu).hu		'his tree'
	b. i.	(ḍá.ra).⟨(ba.to)⟩ (→ ḍárbato *by syncope*)		'she hit him'
	ii.	(bá:).⟨(ra.ko)⟩		'he blessed him'
	c. i.	(mak).(táb).na	*not* *(mák).⟨(tab.na)⟩	'our office'
	ii.	(ba.ka).(rít).na	*not* *(bá.ka).⟨(rit.na)⟩	'our cow'
	d.	(ʕal).(lá.ma).to	*not* *(ʕál.la).⟨(ma.to)⟩	'she taught him'

This provides a highly interesting argument against the uneven trochee. It turns out that in all cases, the portion at the right edge of the word that is invisible to the End Rule corresponds precisely to a moraic trochee, cf. (22b). If uneven trochees were allowed, a foot (– ⏑) would be marked as extrametrical, cf. (22c). Notice that the moraic trochee is crucial in (22d) in medial position as well. The argument is not conclusive, however. An alternative analysis, which has been proposed by Hayes (1987), derives this pattern with syllable extrametricality, rather than foot extrametricality. Cases like (22b) would then be parsed as *(bá:).ra.⟨ko⟩*, where the light penultimate syllable is unable to form a degenerate foot. In support of the latter analysis, it may be observed that no secondary stress falls on the syllable that corresponds to the head of an extrametrical foot in (22b). In support of Hayes' analysis, however, secondary stress does occur in this position in a related dialect, Egyptian Radio Arabic (§6.1.2). This has the pattern of Palestinian, with the difference that foot extrametricality is optional. Words of four light syllables may optionally have the pattern *(ká.ta).(bà.hu)* (with foot extrametricality) or *(kà.ta).(bá.hu)* (without it). Clearly this pattern cannot be derived under syllable extrametricality.

Hindi (§6.1.7) is a weak-prohibition language that assigns moraic trochees from right to left, with End Rule Right, and foot extrametricality:

(23)	a.	(á).⟨(di.ti)⟩	(proper name)
	b.	(ká).⟨(la:)⟩	'art'
	c.	(čú:).⟨(ṛa:)⟩	'bangle'
	d.	(bán).⟨(d^{h}a.na)⟩	'binding'
	e.	(á.nu).⟨(ma.ti)⟩	'approval'
	f.	(á.mi).⟨(ta:)⟩	(proper name)
	g.	ti.(tá.li).⟨(ya:)⟩	'butterfly' (long form)

The analysis of (23a, b) involves a strong degenerate foot due to culminativity, hence Hindi must be a weak-prohibition language. Hayes is silent on the predicted presence of degenerate-size words (the source grammar may not contain information on this). On a conservative point of view, one might consider this evidence for the strong prohibition. If so, the foot structures of (23a, b) must be *(á.di).⟨ti⟩* and *(ká.la:)*, the latter a RESOLVED TROCHEE (Dresher & Lahiri 1991). What emerges is essentially the foot structure of Latin as argued by Mester (1994) and Prince &

Smolensky (1993). The single difference is in words of four light syllables, which in Hindi have pre-antepenultimate stress, while in Latin they have antepenultimate stress. (In Optimality Theory, Hindi might be analysed by constraints proposed by Prince & Smolensky 1993 for Latin, but using the different ranking FTBIN, RHTYPE = T, PARSE-μ ≫ WSP ≫ PARSE-σ ≫ NON-FIN ≫ EDGEMOST.)

A fourth language, Maithili (§6.1.6), assigns foot extrametricality under clash. More precisely, a final foot is rendered extrametrical only when it is directly preceded by a monosyllabic foot that has a long vowel (as in (24a, b), but not in (24c–f)):

(24)	a.	(sá:).⟨(ɬi:)⟩	'woman's garment or cloth'
	b.	(gá:).⟨(bʰi.nə)⟩	'pregnant'
	c.	(pà.ʈə).(hí:)	'thin'
	d.	(dʰà.nə).(hɔ́.rə)	(no gloss)
	e.	(sà).(kʰá:)	'issue'
	f.	(pà).(tí.tə)	(no gloss)

From a comparison of (24a, b) and (24e, f), it transpires that only monosyllabic feet that have a long vowel trigger extrametricality in clash. This condition on the rule is rather unexpected, given the fact that it serves to avoid a clash, and makes Hayes wonder if the initial light syllables of (24e, f) are (degenerate) feet at all. In fact, Maithili has no degenerate-size words. Secondary stress on initial syllables is motivated both by the fact that the source grammar marks it, and by the lack of vowel reduction of initial syllables (all vowels in weak positions of feet reduce). Hayes makes the plausible suggestion that blocking of vowel reduction is due to initial position in the word, rather than to stress.

The interest of Fijian (§6.1.5) resides in TROCHAIC SHORTENING, a rule that shortens a heavy penultimate syllable when followed by a light final syllable. For example, /si:βi/ 'exceed' has two alternants, depending on whether a suffix follows or not: (*sì:*).(*βí.-ta*) 'exceed-TRANS' and (*sí.βi*) rather than *(*sí:*).*βi*, the last form showing the effects of trochaic shortening. Following Prince (1992), Hayes identifies two factors as the pressure behind the rule: (i) avoidance of the uneven trochee (– ∪), and (ii) exhaustive parsing of syllables by feet. Interestingly, a related language, Tongan (Churchward 1953), resolves the same sequence not by shortening the penult, but by breaking it into two syllables, e.g. (*hu:*) 'to go in' *vs.* *hu.*(*ú-fi*) 'to open officially'. This clearly cannot be motivated as an improvement with respect to syllable parsing, but must be due to the requirement that the main stress foot must be in absolute-final position in the word (i.e. EDGEMOST in Prince & Smolensky 1993). Of course, a similar analysis is possible for Fijian as well.

§6.2 discusses syllabic trochee languages. Auca and Icelandic have already been addressed above, and I have nothing to add here. §6.3 contains analyses of some twenty iambic languages (Hixkaryana, half a dozen Algonquian languages, three Iroquoian languages, two Bedouin

Arabic dialects and six Yupik Eskimo languages). A full review would take too much space. I restrict myself to some general characteristics shared by most of these languages, which Hayes summarises at the end of the chapter. In most languages, iambic lengthening fails to apply to *word-final* syllables, an observation for which Hayes has no general explanation. Both Prince & Smolensky (1993) and Hung (1994) point out that this may be deeply connected with the cross-linguistic tendency to avoid word-final stress. Trochaic languages naturally satisfy 'non-finality' by their strong–weak feet. Another way of avoiding final stress is to promote a non-final foot to primary stress, i.e. foot extrametricality in Hayes' theory. Another observation that Hayes makes is that many iambic languages lack the distinction between primary and secondary stress. This may be related to the fact that in most iambic languages, the foot serves as a means to derive a specific durational pattern, rather than a specific prominence pattern. Actually this may be directly related to the Iambic/Trochaic Law. Another plausible interpretation is that main stress is realised primarily by intonational means, and that tones are attracted by edges. Trochaic languages, in which feet naturally pick out the initial and/or prefinal syllable (the latter being the rightmost non-final syllable; see above), are better equipped for promoting than iambic languages, which select the second syllable of the word, one that is not peripheral. Finally, Hayes observes that iambic languages tend to assign feet from left to right. Kager (1993) and McCarthy & Prince (1993) have given different explanations of this iambic directional asymmetry. Kager argues that leftward iambic parsing produces patterns in which clashes and lapses easily occur. At the left edge of the word, an iambic parsing may produce a sequence of two unstressed syllable, e.g. # ∪ (∪ ∪) (∪ ∪) ... Such sequences (initial double upbeats) are known to be avoided cross-linguistically, while the mirror-image pattern with two unstressed syllables at the word end is common (this may again reflect non-finality, in this case of the rightmost foot). This explanation in terms of non-finality is placed in the perspective of a 'non-directional' theory of footing by McCarthy & Prince. They argue that the iambic pattern that appears as 'rightward' is the optimal (most harmonic) parse, in terms of both non-finality and exhaustivity.

Chapter 7 ('Syllable weight') deals with aspects of syllable weight that fall outside the quantitative theory that underlies the asymmetric foot inventory.

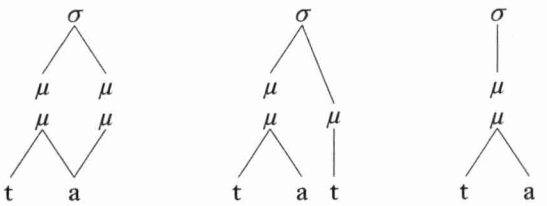
§7.1 introduces a theoretically new distinction between (moraic) syllable quantity and (non-moraic) syllable prominence. The latter is motivated by languages in which stressing depends on properties that have no quantitative basis (e.g. presence of onsets, vowel quality and tone). Typically, a prominence distinction is non-binary, and can be arranged on a multiple-point scale. To capture the scalar nature of prominence distinctions, Hayes follows proposals by Everett & Everett (1984) and Davis (1988) to project prominence distinctions in a hierarchical grid. Stresses are located by End Rules which apply (to the leftmost or rightmost element) at the highest level. Feet, in contrast, are 'blind' to prominence,

and can 'see' moraic quantity only. This does not mean that prominence languages cannot have quantity-based footing as well (Asheninca; §7.1.8).

§7.2 briefly presents Hayes' views on unbounded languages. In essence, he argues that unbounded systems of the 'default-to-opposite' type must be based on feet (the standard analysis ever since Hayes 1980), rather than prominence grids. This predicts that 'default-to-opposite' languages only refer to quantity distinctions, not to those of prominence. In contrast, the analysis of languages of the 'default-to-same' type must be based on prominence grids (cf. Prince 1983), since the leftmost or rightmost syllable at the highest available grid level is promoted (where two grid levels only are required in most cases). Unfortunately, Hayes does not address the important issue of the relationship between unbounded feet and the asymmetric foot inventory.

§7.3 provides a discussion of languages with dual criteria of weight. For example, a language may treat obstruent-closed syllables as heavy for stress, but as light for tonology (Steriade 1991). Also, geminate consonants do not always produce weight (Tranel 1992), as in Maithili (§6.1.6) and Pacific Yupik (§8.8). In a version of moraic theory that recognises only a single representation of weight, one based on mora count, such languages are problematic. In my opinion, Hayes rightfully dismisses the option of manipulating syllable weight during derivations, e.g. by inserting or deleting moras at the point where a particular rule applies, thus 'accounting for' its own specific weight distinction. He instead proposes to extend moraic theory by a two-layered mora grid, adapting an idea of Prince (1983). The height of the grid column over a segment in a syllable segment reflects its relative sonority. The number of grid positions on a row in the mora grid reflects its weight. For example, a language that treats CVC as heavy for one process, but as light for another, can be represented as below:

(25) a. CV: b. CVC c. CV



A CVC syllable can be treated as monomoraic or bimoraic, depending on which level a rule of the mora grid a rule is sensitive to. However, it is not so clear that this proposal actually preserves the major arguments for moraic theory mentioned in §3.9.2: counting (moras, not segments) and preservation (compensatory lengthening). While the number of possible representations increases in the multi-layered mora grid, so do the possible interactions between melodies and weight slots.

Somewhat disappointingly, Hayes deals with Dutch stress in a far

corner of this chapter, entitled 'Miscellanea', where it is lumped together with Aklan, Western Aranda and Madimadi (all highly atypical languages from the viewpoint of Hayes' theory). As I have shown in Kager (1989), the interest of Dutch resides mainly in the fact that it has a typologically uncommon weight distinction, where CVC is heavy while CVV is light. It is correctly pointed out by Hayes that phonetically, CVV syllables are not always long, and in fact may approximate the duration of 'phonologically' short vowels in unstressed positions. But Hayes leaves undiscussed the main source of evidence of phonological length of 'long' vowels, which is distributional rather than stress-based. Moulton (1962) and Trommelen (1983) have argued that the (class of) vowels that may appear in CVV syllables are bipositional since they behave as short vowel plus consonant sequences in a number of phonotactic patterns (e.g. neither 'VV' nor 'VC' may appear before a sequence of sonorant + non-coronal consonant).

Chapter 8 ('Ternary alternation and weak local parsing') addresses stress systems with ternary rhythmic alternations. Hayes convincingly argues that the relatively small set of ternary languages can be analysed without expanding the asymmetric inventory of feet. The tool that serves this goal is 'weak local parsing'. While the typologically unmarked situation is for feet to be assigned 'back-to-back', ternary languages deviate from this by leaving a single light syllable unparsed between two feet. This provides extra support for non-exhaustive foot parsing, a crucial aspect of the theory which had been motivated already as a result of the ban on degenerate feet. Moreover, a number of theoretical problems of earlier theories of ternary feet, related to global look-ahead by metrical parsing, disappear under the weak-local-parsing theory.

The goal of chapter 9 ('Phrasal stress') is to demonstrate that insights about the role of constituency in the phrasal rhythm rule from tree-cum-grid theory (Hayes 1984) can be translated straightforwardly into bracketed-grid theory. Some of these insights are expressed more adequately than previously. In particular, the Maximality Principle (Hayes 1984) and the Strong Domain Principle (Kager & Visch 1988) are explained away as special cases of independently motivated principles, the Faithfulness Condition and the Continuous Column Constraint.

Chapter 10 ('Theoretical synopsis and conclusion') gives a bird's eye overview of the alphabet of metrical atoms, the devices that construct metrical representations, and the conditions on these devices.

5 Conclusions

It will be clear from the above that I judge the positive aspects of the book to outweigh by far its negative aspects. On the positive side, it presents depth of analysis in two ways. It analyses individual languages in remarkable details, and in the context of an internally highly coherent theory. From a typological point of view, it considers a larger number of languages than has ever been analysed in a single body of work in metrical

theory (or perhaps in any other work in linguistics). In fact many languages have not previously been analysed in metrical theory. The result is a book that can rightfully claim to constitute a well-argued body of ideas, based on a wealth of empirical material. It will no doubt form a source of ideas, a testing ground for future work in metrical theory and a standard reference for many years to come.

On the negative side, the analysis of certain types of stress languages is fairly underdeveloped. In fact, the book is almost entirely devoted to a class of languages that one might characterise as 'rhythmic, non-morphological' stress systems. In particular, it shows an apparent lack of coverage of ACCENT SYSTEMS, of the kind that are the home ground of alternative metrical theories such as Halle & Vergnaud (1987) and Halle & Idsardi (1995). Well-known examples are Russian, Lithuanian, Sanskrit, Vedic, Turkish, Modern Hebrew and Salish languages. Moreover, the book pays hardly any attention to languages that have rhythmic feet whose distribution is lexically governed. Or, in terms of Hayes (1980: ch. 5): 'Where does English fit in?' Languages of this type are Dutch, German, Spanish, Modern Greek, Polish and many others. Halle & Vergnaud's theory supplements information (accents) in underlying forms, either by pre-marked brackets or grid marks. The question that arises is whether this information can also be represented in terms of the metrical feet of the restricted inventory that Hayes proposes. If not, this would amount to the conclusion that the notion of 'stress' may, after all, be independent of the notion of 'foot'. This would run against one of the basic tenets of Hayesian theory, i.e. the hypothesis that stress is the linguistic manifestation of rhythmic structure.

Critics might argue that the book ignores most constraint-based work from 1990 on (e.g. Prince 1992) and its culmination in Optimality Theory (OT; McCarthy & Prince 1993; Prince & Smolensky 1993). Actually, there are two excuses for this omission. First, most of the insights in this book are independent of a particular choice of a theory of grammar. In particular, the typological and substantive contributions it makes will remain valid regardless of the type of theoretical tool. Second, the manuscript of this book has in fact been instrumental in shaping OT stress theory: see references in McCarthy & Prince (1993). In fact, the book forms an immediate predecessor of OT in emphasising the surface-oriented nature of phonology. This emphasis is most apparent in §4.5.2 'The Iambic/Trochaic Law and foot inventories', §5.3 'The unstressable word syndrome', §5.4 'Modes of parsing' and §6.1.5 'Trochaic shortening in Fijian and other languages'. The overall orientation is phrased by Hayes clearly on p. 114: 'the rules can be thought of as relatively ad hoc ways of insuring that the representations obey the well-formedness conditions'.

Nevertheless, there are aspects of analyses in the book that will have to be looked into by metrical phonologists who work in constraint-based theory. I summarise cases that lead to surface opacity of metrical structure, apparently requiring some derivation:

(26) *Surface opacity of metrical feet*

a. Syncope plus epenthesis, followed by migration of stress within the foot, e.g. Cyrenaican Bedouin Arabic (§6.3.7) /(yìn).(ga.tí).l-i/ → [yin.gít.lu].

b. Syncope leading to surface degenerate (or ill-formed) feet, e.g. Palestinian Arabic (§6.1.1) /(bá.ka).(ri.to)/ → [bá.kar.to].

c. Foot-governed deletions of weak vowels, with preservation of degenerate feet: Eastern Ojibwa (§6.3.4)/(ni.ná)(ma.dà).(bi.mì)/ → [nnámdàbmì].

d. Different levels of a derivation treating CVV as disyllabic or monosyllabic, e.g. Southern Paiute (§5.6.2) /(tɨ.xʷi).(i.na).(tɨ.βi).(ču.xʷa).(i.ʔi).ŋʷa/ → [tɨχʷí:n:àt:iβʷ`ičuχʷàiʔìŋ^ ḁ].

e. Partial preservation of feet across lexical levels, e.g. Auca (§6.21) /(gǫ́.næ).(ǽ.mæ)#ŋǫ/ → [gǫ́.næ.ǽ.mǽ.ŋǫ].

With these suggestions for future research, I conclude this review.

REFERENCES

Bloomfield, Leonard (1962). *The Menomini language*. New Haven: Yale University Press.

Bolton, Thaddeus L. (1894). Rhythm. *American Journal of Psychology* **6**. 145–238.

Broadbent, Sylvia M. (1964). *The Southern Sierra Miwok language*. Berkeley: University of California Press.

Burzio, Luigi (1988). English stress. In P. M. Bertinetto & M. Loporcaro (eds.) *Certamen Phonologicum : papers from the 1987 Cortona Phonology Meeting*. Turin: Rosenberg & Sellier. 153–175.

Churchward, C. Maxwell (1953). *Tongan grammar*. London: Oxford University Press.

Davis, Stuart M. (1988). Syllable onsets as a factor in stress rules. *Phonology* **5**. 1–19.

Dresher, B. Elan & Aditi Lahiri (1991). *The Germanic foot : metrical coherence in Old English*. *LI* **22**. 251–286.

Everett, Daniel L. & Karen Everett (1984). Syllable onsets and stress placements in Pirahã. *WCCFL* **3**. 105–116.

Freeland, Lucy S. (1951). *Language of the Sierra Miwok*. Bloomington: Indiana University.

Giegerich, Heinz (1985). *Metrical phonology and phonological structure*. Cambridge: Cambridge University Press.

Halle, Morris & William Idsardi (1995). Stress and metrical structure. In John A. Goldsmith (ed.) *The handbook of phonological theory*. Cambridge, Mass. & Oxford: Blackwell. 403–443.

Halle, Morris & Jean-Roger Vergnaud (1987). *An essay on stress*. Cambridge, Mass.: MIT Press.

Hammond, Michael (1984). *Constraining metrical theory : a modular theory of rhythm and destressing*. PhD dissertation, UCLA.

Hayes, Bruce (1980). *A metrical theory of stress rules*. PhD dissertation, MIT.

Hayes, Bruce (1984). The phonology of rhythm in English. *LI* **15**. 33–74.

Hayes, Bruce (1985). Iambic and trochaic rhythm in stress rules. *BLS* **13**. 429–446.

Hayes, Bruce (1987). A revised parametric metrical theory. *NELS* **17**. 274–289.

Hulst, Harry van der (1984). *Syllable structure and stress in Dutch*. Dordrecht: Foris.

Hung, Henrietta (1994). *The rhythmic and prosodic organization of edge constituents*. PhD dissertation, Brandeis University.

Kager, René (1989). *A metrical theory of stress and destressing in English and Dutch.* Dordrecht: Foris.

Kager, René (1992). Shapes of the generalized trochee. *WCCFL* **11**. 298–311.

Kager, René (1993). Alternatives to the iambic–trochaic law. *NLLT* **11**. 381–432.

Kager, René (1995). Consequences of catalexis. In H. van der Hulst & J. van de Weijer (eds.) *Leiden in last*. The Hague: Holland Academic Graphics. 269–298.

Kager, René & Ellis Visch (1988). Metrical constituency and rhythmic adjustment. *Phonology* **5**. 21–71.

Keyser, Samuel J. & Paul Kiparsky (1984). Syllable structure in Finnish phonology. In M. Aronoff & R. Oehrle (eds.) *Language sound structure*. Cambridge, Mass.: MIT Press. 2–31.

Kiparsky, Paul (1991). Catalexis. Ms, Stanford University & Wissenschaftskolleg zu Berlin.

Liberman, Mark (1975). *The intonational system of English*. PhD dissertation, MIT.

Liberman, Mark & Alan Prince (1977). On stress and linguistic rhythm. *LI* **8**. 249–336.

McCarthy, John & Alan Prince (1986). *Prosodic morphology*. Ms, University of Massachusetts, Amherst & Brandeis University.

McCarthy, John & Alan Prince (1993). *Prosodic morphology I: constraint interaction and satisfaction*. Ms, University of Massachusetts, Amherst & Rutgers University.

Mester, Armin (1994). The quantitative trochee in Latin. *NLLT* **12**. 1–61.

Moulton, W. G. (1962). The vowels of Dutch: phonetic and distributional classes. *Lingua* **11**. 294–313.

Pike, Kenneth (1964). Stress trains in Auca. In D. Abercrombie, D. B. Fry, P. A. D. MacCarthy, N. C. Scott & J. L. M. Trim (eds.) *In honour of Daniel Jones*. London: Longman. 425–431.

Prince, Alan (1980). A metrical theory for Estonian quantity. *LI* **11**. 511–562.

Prince, Alan (1983). Relating to the grid. *LI* **14**. 19–100.

Prince, Alan (1992). Quantitative consequences of rhythmic organization. *CLS* **26:2**. 355–398.

Prince, Alan & Paul Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar*. Ms, Rutgers University & University of Colorado, Boulder. To appear, MIT Press.

Selkirk, Elisabeth O. (1984). *Phonology and syntax: the relation between sound and structure*. Cambridge, Mass.: MIT Press.

Steriade, Donca (1991). Moras and others slots. *Proceedings of the Formal Linguistics Society of Midamerica* **1**. 254–280.

Tranel, Bernard (1992). CVC light syllables, geminates and Moraic Theory. *Phonology* **8**. 291–302.

Trommelen, Mieke T. G. (1983). *The syllable in Dutch, with special reference to diminutive formation*. Dordrecht: Foris.

Woodrow, Herbert (1909). A quantitative study of rhythm. *Archives of Psychology (New York)* **14**. 1–66.

Yip, Moira (1992). On quantity-insensitive languages. Ms, University of California at Irvine.