4
Feet and words

4.1 Introduction: stress and accent

In dictionary entries we often find a symbol, adjacent to or above one of the letters of a word, to indicate the location of what is usually referred to as 'stress'. If a phonetic or phonemic transcription is given in addition to the orthographic form, the symbol is often a small vertical line, placed before the stressed syllable, as in (1a), or an accent on the vowel, as in (1b) (in this book we have been using the system in (1a), and will continue to do so in this chapter):

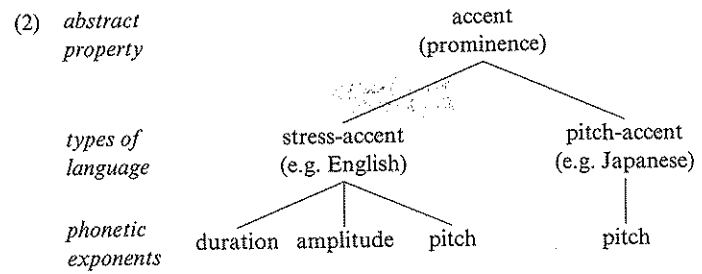
(1)	a.	/ˈdʌnʤən/	dungeon	b.	/dʌ́nʤən/
		/ˈmɛθədɪzəm/	methodism		/mɛ́θədɪzəm/
		/rɪˈbeljən/	rebellion		/rɪbéljən/

This is of course meant to provide information about the correct pronunciation of the word. Thus the syllable following the vertical line in (1a) is pronounced in such a way that it is perceptually more 'prominent' or 'salient' than the other syllables. In a language like English, this syllable is normally characterised as being stressed. The exact phonetic correlates of stress are notoriously difficult to establish.[1] For the moment let us simply assume that prominence is achieved by enhancing various phonetic properties, e.g. duration, amplitude and pitch.

However, there are other languages – of which Japanese is an often quoted example (see e.g. McCawley 1968, Haraguchi 1977) – in which the primary indicator of relative prominence is pitch alone, with other phonetic properties playing a much less important role. Such languages are often referred to as having **pitch accent**, while languages like English are called **stress-accent** languages. In the remainder of this chapter we will use the term **accent**, rather than stress, to characterise the abstract property of 'prominence', as indicated in (2):

[1] For detailed discussion, see e.g. Sluijter (1995), van Heuven and Sluijter (1996), Dogil (1999).

(2)



In what follows we will not be concerned with the phonetic cues (or phonetic exponents) that signal the accent to the listener, whether these be in a pitch-accent or a stress-accent language.

The information provided by the symbol indicating the position of the accent is relevant to the pronunciation of all syllables of the word, even those that do not bear accent. In English, unaccented syllables are typically pronounced with a lax manner of articulation, leading to vowel reduction. Indeed, in English, the least accented syllables usually contain schwa, the most reduced vowel, which is never found in accented syllables (cf. the discussion in §1.3.2). Thus, even though the accent symbol is associated with a particular syllable, it gives information about the accentuation of the entire word.[2] Each accent, then, signals the presence of one accentual **domain**. In many languages, this domain corresponds to the notion of 'word', so that between any two accents there must always be a word boundary. Accents may thus play a role in parsing sentences into words. In fact, in languages where the location of accent is on a fixed syllable in the word (e.g. the first one, as in Icelandic, Hungarian or Czech), the exact boundary between words can be uniquely determined. Thus, accent can have what is called a **demarcative** function.

The placement of accent may be predictable according to certain rules in the language, or it may be a non-predictable property of individual words, i.e. it has to be specified in the lexical representations of the morpheme or morphemes making up a particular word. Languages thus vary according to whether accent is rule-governed or lexical. Polish, for example, is generally considered to be a language in which the placement of accent is largely predictable, regularly falling on the penultimate syllable, as illustrated by the forms in (3) (from Halle and Vergnaud 1987a: 57):

(3)	hipoˈpotam	NOM SG	'hippopotamus'
	hipopoˈtam-a	GEN SG	
	hipopotam-ˈami	INSTR PL	

[2] This property of accent is often called **culminativity**, i.e. 'each word or phrase has a single strongest syllable bearing the main stress' (Hayes 1995: 24).

Thus the addition of the suffix forces the accent to move from its original position in the unsuffixed stem to the penultimate syllable, even though this syllable may itself be part of the suffix, as in the disyllabic instrumental plural suffix *-ami*. Polish accent placement, then, is predictable on the basis of the position of the syllable in the word. On the other hand, Russian appears to need to have accent specified lexically for nearly all of the morphemes in the language, given the existence of pairs of words differing only in the placement of accent (cf. Revithiadou 1999: ch. 3):[3]

(4) 'glaski 'eyes (DIM)' vs glas'ki 'peepholes'
'muka 'torture' vs mu'ka 'flour'

In many languages in which accent placement is predictable, it is the segmental make-up of the syllables which is relevant, as well as the position of a syllable in a word; thus heavy syllables (cf. the discussion in §3.4.1) are more likely to bear accent than light ones. In some languages, the accentual rules first seek out a heavy syllable, and only if they fail to find one in the relevant domain will accent be assigned to a syllable in a particular position in that domain (we return to this in §4.4.6).

Returning to our dictionary, we find that words consisting of a single syllable are usually not provided with an accent symbol; cf. e.g. disyllabic /'braɪdgruːm/ *bridegroom*, with an accent symbol, and monosyllabic /braɪd/ *bride*, without. Clearly, though, the single syllable of *bride* can bear accent, cf. (5a) and (b):

(5) a. The 'bride a'greed.
b. The 'bridegroom a'greed.

In both cases the syllable /braɪd/ is accented.

To the user of the dictionary this causes no problems, since, in monosyllabic words such as these, the accent falls on the only syllable.[4] Notice that the fact that a monosyllable can bear accent suggests that 'being accented' is not purely a relative notion. This is confirmed by the fact that monosyllabic words in English can be divided into two categories, those in which the vowel is never reduced, and those which are typically – often obligatorily – pronounced with a reduced vowel, e.g. schwa. As we might expect, the words

[3] The situation in Russian is not as straightforward as we are suggesting here; various aspects of accentuation in the language are in fact rule-governed, especially in situations where the number of lexically determined accents in a single accentual domain is either none or two. See §4.3.1 for further discussion of this. Nevertheless, the basic characterisation of Russian as involving 'free' accent is generally accepted.

[4] In some languages, however, accented monosyllabic lexical items are not permitted. These languages demand that a phonological word be minimally disyllabic. We consider this phenomenon in §4.4.

which have full vowels are typically accented. This is the class often referred to as **lexical words**, e.g. nouns, adjectives and verbs. On the other hand, the words which normally occur only with reduced vowels are not generally accented, and belong to the closed class of **grammatical words**, such as determiners (e.g. /ðə/ *the*), pronouns (e.g. /ðəm/ *them*) and prepositions (e.g. /ət/ *at*, /tə/, /tʊ/ *to*).[5]

Any utterance, then, consists of a sequence of accented and non-accented syllables. In probably all languages, utterances have an **intonational melody** (Bolinger 1978), created by the way in which the pitch changes during the utterance. The manner in which the pitch movements that make up this melody are lined up with the words in the utterance provides information as to which parts of the utterance are 'important'. In addition, intonation contours also provide cues to the overall syntactic and semantic structure of utterances, i.e. the grouping of words into meaningful 'chunks'.

In English, perceptual salience is given to the important parts of an utterance by lining up the accented syllables of certain words with specific pitch targets or pitch movements. That is, an accented syllable may be realised on a higher pitch than the syllables surrounding it, so that the listener can easily identify it, or a constituent (a word or phrase) of which it forms part, as important. Such syllables are said to bear **pitch peaks**. Consider for example the sentence *Britten composed a lengthy symphony* /'brɪtən kəm'pəʊzd ə 'lɛŋθɪ 'sɪmfənɪ/. We might represent the structure of this sentence as in (6):

(6)
H
|
Britten composed [A LENGTHY SYMPHONY]

Here the pitch peak, represented by H (for high tone), is associated with the first syllable of *symphony*.

Let us assume that the above utterance is an answer to the question *What did Britten compose?* The important constituent of the utterance is in this case *a lengthy symphony*. This constituent is **in focus** (indicated in (6) by capitalisation), and the pitch peak is lined up with the accented syllable in the constituent. Unaccented syllables are not normally candidates for bearing a pitch peak; for example, the second syllable of *symphony* (/fə/) in (6) could not bear a peak.

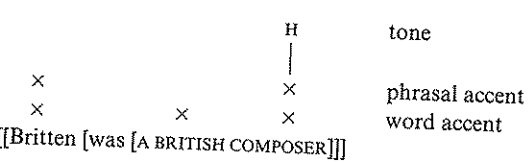
Note that there may be more than one accented syllable in an utterance which can potentially form the pitch peak. For example, if we align the H tone in *Britten composed a lengthy symphony* with the accented syllable of the

[5] For a discussion of the use of such reduced or weak forms in RP, see e.g. Collins and Mees (1996: §3.4).

word *lengthy*, the utterance would be more likely to be an answer to a question such as *What kind of symphony did Britten compose?* In the answer to this question, the constituent in focus is *lengthy*, as in (7) (as indicated, *a lengthy symphony* is still a constituent within the utterance, even though it is not in focus):

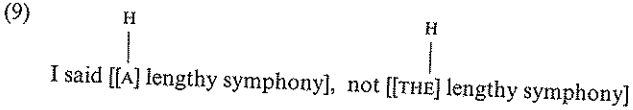
(7)


The rules governing the location of intonational pitch peaks in English are highly complex, and we will not discuss them here.[6] However, it is clear that, just as a lexical word contains one word accent, so a phrase contains one **phrasal accent**. Thus, a particular syllable may be accented with reference to several inclusive domains, as shown in (8), *Britten was a British composer* /'brɪtən wəz ə 'brɪtɪʃ kəm'pəʊzə/ (a possible answer to the question *Who was Benjamin Britten?*):

(8)


(We use × to denote the presence of an accent at the relevant level.) Here the first syllable of *Britten* and the second syllable of *composer* bear both word accents and phrasal accents – they are the heads of their respective phrasal constitutes. In addition, the second syllable of *composer* also bears the pitch peak of the entire utterance. The first syllable of *British*, however, has only word accent.

In (8) it is not possible to associate a high tone with either of the words that belong to closed classes (*was* and *a*), in order to show that the phrases of which they are part (*was a British composer* and *a British composer*, respectively) are in focus. Such words can only bear pitch peaks if they are themselves placed in focus, normally in some kind of contrastive context, as in (9):

(9)


In this case, the unaccented word is not properly contained in a focused constituent, but rather itself forms a focused constituent. Notice that in such

[6] See e.g. Fuchs (1976), Gussenhoven (1984), Baart (1987), Selkirk (1984a, 1995) and Ladd (1996) for extensive discussion of these issues.

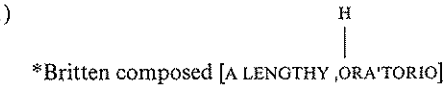
cases the word is pronounced with a full vowel, rather than in its normal weak form.

This strategy can also be used to place normally unaccented syllables in polysyllabic words in focus, yielding utterances such as *I didn't say Ham*[LET], *but Ham*[BURG]. Again the focused syllable will be pronounced with a full vowel, e.g. /hæm'lɛt/, not */hæm'lət/.

Up to now we have been assuming that only one syllable in polysyllabic words can be accented. However, this is clearly not the case; in many dictionaries a second symbol is used to indicate what is referred to as **secondary** or **non-primary** accent, as in (10a). Indeed, when words are sufficiently long, more than one non-primary accent can be found, as in (10b):

(10) a. /'hʌrə,keɪn/ hurricane
/'tɛlə,fəʊn/ telephone
/'kɒmpən,seɪt/ compensate
/,kɒmpən'seɪʃən/ compensation
/,ɪnstrə'mɛntəl/ instrumental
b. /,ɪnstrə,mɛn'tælɪtɪ/ instrumentality
/,æpə,læʧɪ'kəʊlə/ Apalachicola

The indication of non-primary accents shows that not all syllables lacking the primary accent are felt to be equal in salience. In English, for example, syllables marked with a non-primary accent symbol typically do not display reduction to schwa. Rather, like primary accented vowels, they have a full-vowel quality.[7] Nevertheless, such syllables are less salient than primary accented syllables. Furthermore, they normally cannot be associated with pitch peaks, so that (11) is not possible:

(11)


Although it is possible to distinguish degrees of non-primary accents, many lexicographical works do not distinguish between, for example, secondary accent and tertiary accent. However, Gimson, in his introduction to Jones (1977), observes: 'Many long polysyllabic words or compounds have two secondary stresses preceding the primary, e.g. "cross-examination, decontamination, mispronunciation, intercontinental", etc. Of the two secondary stresses, the first is the stronger . . . I have chosen to use ' for the first secondary, e.g. "cross-examination" /'krɒsɪg,zæmɪ'neɪʃn/ with the convention that

[7] Some words have alternative realisations, such as *hurricane*, whose final syllable may either bear secondary accent (/'hʌrə,keɪn/) or be unaccented (/'hʌrəkən/). The quality of the vowel depends on whether the syllable bears accent.

the first sign ' is subsidiary to the second ' (1977: xxiii)'. At least the distinction between primary and secondary accent is represented in most dictionaries.

In our discussion so far, we have suggested that the presence of an accent signals the presence of some domain. Thus a primary accent signals the word domain and a phrasal accent signals the phrasal domain, as shown in (8) above. Given this understanding of the notion accent, secondary accents must be properties of a domain that is smaller than the word. This non-primary accent domain is the **foot**, which we introduced in our discussion of the prosodic hierarchy in §3.1, and whose existence we will defend in §4.2. Words, then, may consist of more than one foot, so that *oratorio*, for example, has two foot accents, but only a single word accent, as in (12):

(12)
```
      ×        word accent
  ×   ×        foot accent
  oratorio
```

The introduction of the foot allows us to extend the notation of (8) as in (13), for the phrase *a lengthy oratorio* /ə ˈlɛŋθɪ ˌɒrəˈtɔːrɪəʊ/:

(13)
```
                    H                    tone
                    |
(·                  ×        )           phrasal accent
(×    )(·           ×        )           word accent
(×  ·)(×  ·)(×  ·  ·)                     foot accent
σ  σ  σ  σ  σ  σ  σ  σ
ə  lɛŋ θɪ  ɒ  rə  tɔː rɪ  əʊ
```

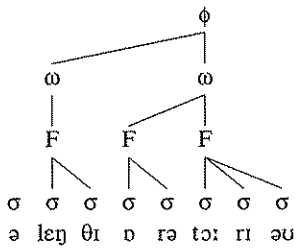
At the lowest level syllables are gathered up into feet, by procedures which we consider in detail in the remainder of this chapter. This gives the three feet *lengthy*, *ora-* and *-torio* in (13). From now on we indicate the unaccented syllables in a foot with a dot, and the accented syllable with ×. Notice that the initial syllable of the phrase, *a*, remains unfooted, and is therefore not marked with a dot. This is typical of **clitics**, i.e. unaccented grammatical words which normally occur in their weak form, and which are not incorporated into the foot structure.[8] The feet are organised into phonological words; each word bears one word accent. At this level, we mark those foot accents which are not selected as word accents with dots. In general, then, × indicates the head of any domain; · its dependent sister or sisters. Finally, the words are combined to form the single phrase in (13). There being only one phrase, the phrasal accent also bears the pitch peak. The hierarchical structure in

[8] This is a simplification: clitics and, more generally, syllables with unaccentable vowels must ultimately be incorporated into the prosodic structure, either at the foot level or at higher levels (cf. Itô and Mester 1992; Peperkamp 1995; Nespor 1999).

(13) is referred to as a **bracketed metrical grid** (cf. Halle and Vergnaud 1987a; Hayes 1987, 1995). As we have already pointed out, each domain – foot, word and phrase – is characterised by a *single* accent, i.e. there is a single syllable which is 'stronger' than the others. This is the principle of culminativity mentioned in note 2 above.

We should notice that bracketed metrical grids are formally equivalent to tree structures incorporating headship, of the type which we used to characterise syllable structure in Chapter 3. The tree in (14) is equivalent to the grid in (13):

(14)



We use here the symbols for foot, word and phrase introduced in (9) in Chapter 3. In what follows, however, we will represent accent in terms of the grid.

4.2 Feet

The term **foot** is familiar from the study of the metre of traditional verse-forms. Verse of this sort makes use of a number of different foot types, among which the **trochee** and the **iamb** are the most familiar, and, indeed, the simplest. These two metrical foot types involve alternations between accented and unaccented syllables; syllables are thus grouped into pairs, and therefore form **binary** feet. Trochaic and iambic feet differ in their **prominence** or **salience** patterns; in trochaic feet, the first syllable is more prominent than the second, while in iambic feet the opposite relation holds. This is shown in (15), which uses the notation of Kiparsky (1977) and Hayes (1983):

(15) a. *Trochaic*
```
s  w  s  w  s  w  s  w  s  w  s  w
(σ  σ) (σ  σ) (σ  σ) (σ  σ) (σ  σ) (σ  σ)
```
b. *Iambic*
```
w  s  w  s  w  s  w  s  w  s  w  s
(σ  σ) (σ  σ) (σ  σ) (σ  σ) (σ  σ) (σ  σ)
```

Here 'w' denotes the weak syllable of a constituent, and 's' the strong syllable. Thus the trochaic pattern can be represented as in (16a) (from Longfellow's

poem 'The Song of Hiawatha'), and the 'prototypical iambic pentameter' (from Shakespeare's *Richard III*; Kiparsky 1977: 189) as in (16b) (where ´ marks a strong syllable, and ˘ a weak syllable):

(16) a. s w s w sw s w
(Ón thĕ) (shóre stŏod) (Hí-ă)-(wá-thă)
s w s w s w s w
(Túrned ănd) (wáved hĭs) (hánd ăt) (pár-tĭng)
b. w s w s w s w s w s
(Thĕ lí)-(ŏn dý)-(ĭng thrúst)-(ĕth fórth) (hĭs páw)

In verse traditions such as these, the number of syllables in a foot is usually fixed; in the case of trochaic and iambic patterns, there is exactly one accented and one unaccented syllable. In patterns with more than two syllables, the foot will still have only one *accented* syllable – as we have seen, the foot domain is defined as containing one accented syllable – but more than one unaccented syllable. Thus a **dactylic** pattern is shown in (17):

(17) *Dactylic*
s w w s w w s w w s w w
(σ σ σ) (σ σ σ) (σ σ σ) (σ σ σ)

This pattern is illustrated in (18) (from Ralph Hodgson's 'Eve'):

(18) s w w s w w
(Éve wĭth hĕr) (bás-kĕt wăs)
s w w s w w
(Déep ĭn thĕ) (bélls ănd grăss)

These verse patterns involve what Hayes (1995: 372) refers to as **eurhythmicity**. Eurhythmic patterns are those in which accents 'are spaced not too closely and not too far apart'. More generally, the optimal eurhythmic pattern is one in which the accented syllables are equally spaced.[9]

This pattern is clearly achieved if the number of unaccented syllables between the accented syllables remains constant (one in the case of iambic and trochaic patterns; two in the case of dactylic patterns). However, this is not a prerequisite – the distance between the accented syllables can remain constant, even though the number of intervening unaccented syllables varies. In this view of verse structure, the foot is essentially interpreted as a unit of **timing**: a line of metrical verse consists of a fixed number of feet, with the

[9] It is possible to suggest that such rhythmic considerations determine the occurrence of what we referred to as 'secondary accents' in §4.1. That is, after primary accent has been assigned in a word, any remaining sequence of unaccented syllables, if it is sufficiently long, will be assigned a 'rhythmic pattern', thus avoiding what are sometimes referred to as a rhythmic 'lapse' (a sequence of too many unaccented syllables; see e.g. Selkirk 1984a; Nespor and Vogel 1989; Visch 1989).

accented syllables being roughly **isochronous** – i.e. they tend to recur at roughly equal intervals of time. The concept of the foot in verse is thus more or less equivalent to that of the bar or measure in music, with the accented syllable being equivalent to the first (strong) beat of the bar. Abercrombie (1965: 22), for example, provides the following scansion:

(19) w w s ww s w w s w s
'Tĭs thĕ (míd-dlĕ ŏf) (níght bў thĕ) (cás-tlĕ) (clóck)

We ignore here the first two syllables, which on this analysis do not form a foot, but rather belong to the final foot of the previous line, if present. Notice that the number of unaccented syllables in the four complete feet varies from zero to two. Nevertheless, the accented syllables occur at regular intervals of time – they are more or less equally spaced.

The rhythm of this type of verse, then, depends on the structure of verse-feet, rather than on simply counting the number of syllables, which would be a possible strategy for the type of verse in (16).[10] But there are other metrical phenomena which are clearly foot-related. Germanic alliterative verse, for example, involves alliteration between stressed syllables, i.e. between the onsets of the first syllables of feet, as evidenced by the following extract from the Old English epic poem *Beowulf* (lines 4–7):

(20) Oft 'Scyld 'Scēfing 'sceaþena 'þreatum,
'monegum 'mǣgþum 'meodo-setla of'tēah;
'egsode 'Eorle, syððan 'ærest 'wearð
'fēasceaft 'funden; hē þæs 'frōfre ge'bād.[11]

where the initial syllable of the first three feet of each line must alliterate (in the first line on /ʃ/ (perhaps /sc/) <sc>, in the second on /m/, in the third on an empty onset and in the fourth on /f/).

Within this essentially verse-based approach to the foot, it is often argued that the temporal organisation of verse extends to the rhythmic organisation of spoken language (e.g. Abercrombie 1964). In a language like English, then, any of the structures in (21) would be permissible (we use the bracketed grid notation of (13) above):

[10] Indeed, Abercrombie notes that Samuel Taylor Coleridge, in his preface to his poem 'Christabel' in 1816, from which (19) is taken, observes: 'The metre of "Christabel" is . . . founded on a new principle: namely, that of counting in each line the accents, not the syllables . . . in each line the accents will be found to be only four.'

[11] Scyld Scefing often deprived his enemies,
many tribes of men, of their mead-benches,
He terrified his foes; yet he, as a boy,
had been found a waif; fate made amends for that.
(from *Beowulf*, translated by K. Crossley-Holland (1968). London: Macmillan)

(21) a. (× ·) b. (× · ·)
σ σ σ σ σ

c. (× · · ·) d. (× · · · ·)
σ σ σ σ σ σ σ σ σ

where the different types of foot are instantiated by the forms in (22):

(22) a. silly b. syllable c. sedentary d. generalising

This approach is motivated by the claim that English is a 'stress-timed' language, i.e. one in which the 'rhythmic pulse' or the 'beat' of the language is determined by the timing relationship between *accented* syllables. That is, each accented syllable coincides with an isochronous beat – the distance between them is roughly the same. Stress-timed languages such as English are often contrasted with 'syllable-timed' languages such as French, in which isochrony is attributed not to stressed syllables, but to syllables in general. Thus, in a syllable-timed language, 'each syllable is aligned with a . . . beat in the metrical grid' (Selkirk 1984a: 41). One way of interpreting this is to say that every syllable forms a rhythmic foot by itself, on the assumption that the foot is the basic unit of rhythm. Even in syllable-timed languages, however, it has been argued that the foot may be branching: thus Selkirk (1978) argues that the foot in French consists either of one syllable, as just outlined, or of two, but only if the second syllable contains [ə]. Thus foot structure in French can be illustrated by (23), for *mon petit garçon* /mɔ̃ pəti gaʀsɔ̃/ 'my little boy':[12]

(23) (× ·) (×) (×) (×) foot accent
σ σ σ σ σ
mɔ̃ pə ti gaʀ sɔ̃

Thus only two foot structures are possible in French: unary and binary.

The approach just outlined appears to allow for a wide range of foot types, ranging from the unary feet in (23) to **unbounded** feet containing a large number of syllables, such as (22d). However, the unbounded structure in (22d) ignores the secondary accent on the fourth syllable of *'genera,lising*, which might better be represented as containing two feet, as in (24) (cf. also (13) above):

(24) (× · ·) (× ·) foot accent
σ σ σ σ σ
ge ne ra li sing

[12] The distinction drawn here between stress-timed and syllable-timed languages is not uncontroversial, and is certainly not as simple as suggested here (see e.g. Dauer 1983; Nespor and Vogel 1989).

The two feet in (24) together form a word, in which the first accented syllable is the more prominent, as shown in (25):

(25) (× ·) word accent
(× · ·) (× ·) foot accent
σ σ σ σ σ
ge ne ra li sing

How, though, do we know which syllable in a foot will bear the accent, and, indeed, which of the accented syllables will be the most prominent, i.e. primary?

Notice that all the foot types which we have considered so far display one common property: the accented syllable occurs at one of the **edges** of the foot. In the case of trochaic and iambic patterns, this is trivial, of course – the accented syllable *must* be at an edge: it is the first of two in the case of a trochaic foot and the second of two in the case of an iambic foot. In larger feet, however, this still holds. Thus the accented syllable in a dactylic foot (s w w) is at the left edge. Typically though, we do not find foot types such as w s w, in which the accented syllable is in the middle of the foot.[13]

Moreover, primary accents, as we shall see, also prefer to occur at the edge of a word. In general, then, the strong element of any constituent prefers to be **peripheral**, as pointed out by Liberman (1975). This also mirrors principles of versification, in which, again, initial and/or final feet tend to be the most prominent in the line. Liberman suggests that the edge preference of primary accent and the alternating character of non-primary accents follow naturally if we assume that assigning accent involves first grouping syllables into feet and then assigning primary status to the accent of the leftmost or rightmost foot within the domain in question.

4.3 Fixed accent and free accent systems

We return now to the difference between the two types of accent systems discussed briefly in §4.1, those in which the accent apparently falls on a particular syllable in the word, i.e. **fixed accent systems**, as opposed to those in which the placement of accent is not predictable from the syllabic structure of the word, i.e. **free accent systems**. In particular, we will be considering the status of English with respect to this distinction. Why is it, one may ask, that accents are indicated on a word-by-word basis in English dictionaries? This would appear to suggest that English is not a language with fixed accent, unlike for example Polish (which we saw in (3) appears to be a language

[13] We should note, however, that appeal has sometimes been made to the w s w foot type, the **amphibrach**, notably by Halle and Vergnaud (1987a), in their analysis of Cayuvava, which we consider in §4.4.5.

which has accent fixed on the penultimate), Finnish (fixed initial accent) or Tübatulabal (a language spoken in Southern California which has fixed final accent). In all these languages, the location of accent is predictable by reference to (distance from) one of the word-edges.

The large number of possible accent patterns in English, illustrated in (26), suggests at first sight that it is a language more like Russian, i.e. one in which accent is free:

(26) 'abstract (ADJ, NOUN) 'marma,lade
ab'stract (VERB) se'rene
ca'sino ,Apalachi'cola

This range of possible patterns means that English dictionaries, as we have already observed, tend to mark the accents in each word. However, we will show below that the placement of stress in many English words is in fact predictable, so that it does not provide an example of a free accent system. Indeed, the terms fixed vs free accent refer to extreme situations that are probably not encountered in any language in an absolute sense. Anderson (1984) observes that Avar, a northeast Caucasian language, provides an example of a system in which 'stress can only occur on one of the first two syllables of the word, but beyond this it is unpredictable', as shown in (27) (data from Ebeling 1966: 59):

(27) 'hoc:'o 'threshing floor' hoc:''o 'honey'
'q'adal 'wall (GEN SG)' q'a'dal 'wall (NOM PL)'

That is, accent is 'fixed' in the sense that it must occur within the 'window' formed by the first two syllables, but is 'free' in the sense that there is no way of predicting which of these syllables will bear the accent in any particular word (although, as Anderson observes, 'some grammatical categories are associated with stress on a particular syllable', so that the difference in the patterns for the genitive singular and nominative plural forms for 'wall' in (27) can be attributed to predictable morphological factors).

Similarly, there is probably no fixed-accent language in which the accent is located in accordance with a rule that refers to word-edge and nothing else in *all* the words (simple and complex) of the language. In this respect, let us consider Polish, an example of a fixed-accent language, in a little more detail. Although Polish has regular penultimate accent (28a), we find morphologically simple words that have antepenultimate accent (28b) and also some that have final accent (28c):

(28) a. regular *penultimate* mar'molad 'marmalade (GEN PL)'
wi'osna 'spring'

b. irregular *antepenultimate* uni'wersitet 'university'
gra'matyka 'grammar'
c. irregular *final* re'żim 'regime'
me'nu 'menu'

Exceptions such as those as in (28b, c) (which in Polish are often loanwords) can only be dealt with by providing their lexical representations with an indication of which syllable is accented; the regular cases bear no such indication.

However, more interesting are those cases in which apparent exceptions themselves form a subsystem of some kind, so that a language may be said to have more than one regular pattern. This is often determined by some non-accentual property, very often membership of a specific word class (just as in Avar above), such that nouns behave differently from verbs, for example. Thus, morphological properties often interfere with the basic accentual principles of a language. Some of the apparent irregularity in English is caused by factors such as these, as we shall now show.

Chomsky and Halle (1968) provide the first extensive generative analysis of accent in English, and we consider the principles of their analysis briefly here. On the basis of the forms in (29), we might conclude that English takes primary accent on the final syllable:

(29) a. ap'pear sur'mise
col'lapse u'surp
b. su'preme re'mote
ro'bust ab'surd

However, the words in (30) appear to contradict this claim:

(30) a'rena an'gina
sy'nopsis fi'asco

Chomsky and Halle observe that this difference is due to the different morphological categories of the words involved: those in (29a) are verbs and those in (29b) adjectives, while the words in (30) are nouns. Thus stress falls on the final syllable if the word is a morphologically simple verb or adjective, but on the penultimate if it is a noun.

Another way in which morphology yields apparent counterexamples to the stress patterns of a language involves affixation. For example, we have just seen that the adjectives in (29b) behave like verbs in taking accent on the final syllable. However, as Chomsky and Halle (1968: 81) point out, the adjectives in (31) apparently deviate from this pattern:

(31) ,anec'dotal ,uni'versal
mo'mentous de'sirous

However, these items are morphologically complex:

(32) ANECDOTE+AL UNIVERSE+AL
MOMENT+OUS DESIRE+OUS

Whatever the accentual pattern of the word from which the adjective is derived, the primary accent falls on the syllable immediately preceding the derivational suffix.[14]

Other suffixes are 'accent-neutral'; they have no effect on the stress pattern of the word to which they attach:

(33) a. di'vinely DIVINE+LY
'vulgarly VULGAR+LY
b. ma'rinehood MARINE+HOOD
'adulthood ADULT+HOOD[15]
c. e'xactness EXACT+NESS
'wanton WANTON+NESS

Whatever the details, it is apparent that English is not a free-accent language. Rather, there are a number of interacting principles which determine the accentual pattern, one of which, the internal structure of the 'target' syllable, we consider below in §4.4.2. Moreover, even though English has words containing a large number of syllables, the syllable which bears the primary accent is virtually always one of the final three:

(34) ˌApalachi'cola[16] ˌarchi'pelago
ˌWinnipe'saukee a'sparagus
ˌConstanti'nople ge'ranium

Notice again that the suffixation of accent-neutral affixes may override this restriction:

(35) a. 'desperately DESPERATE+LY
b. 'bachelorhood BACHELOR+HOOD
c. ad'venturousness ADVENTURE+OUS+NESS

Morphology can play a role even in languages such as Russian, which, as we have seen, is considered to have a free-accent system. A language like

[14] We return in §4.4.2 to the reasons for the antepenultimate accent in words such as *maximal* and *rigorous*. This has to do with the weight of the rhyme of the target syllable for accent (the penultimate, in these cases).

[15] For speakers whose pronunciation is /ə'dʌlt/, stress on the derived noun remains on the second syllable: /ə'dʌlthʊd/.

[16] The reader may wonder why we choose to illustrate our argument with such apparently exotic English words. A perusal of the literature on accent would quickly yield a large number of such items. This appears to be a consequence of the fact that it is difficult to find *morphemes* in English consisting of so many syllables; 'native' polysyllabic English words tend to be compounds or contain prefixes and/or suffixes, e.g. *excommunication*.

Russian is a **lexical accent language**, as accentuation has to be marked in the lexicon. However, even in such free systems we find regularities in morphologically complex words: when morphemes are combined to form words, rules will decide which syllable will receive the primary (i.e. word) accent. Revithiadou (1999) observes data such as the following:[17]

(36)		NOM SG		NOM PL		
	a.	golova	[gələ'va]	golovy	['gɔləvɨ]	'head'
	b.	rabota	[rə'bɔtə]	raboty	[rə'bɔtɨ]	'work'
	c.	gora	[gə'rə]	gory	[gə'rɨ]	'mountain'

It will be seen that the relationship between the accentual patterns of the singular and plural forms of these three Russian nouns is different in each case. This can be explained by assuming that morphemes differ in Russian in being lexically either marked or unmarked for accent. That is, although Russian is a free-accent language, not every morpheme is lexically accented. Furthermore, certain morphemes may be lexically marked as being 'unaccentable' – they reject accent wherever possible. The various morphemes in (36) can be assigned the following lexical accentual properties:

(37)					
a.	*unmarked*	golov-	/gɔlɔv/	'head'
		-y	/ɨ/	'FEM NOM PL'
b.	*marked*			
	accented	ra'bot-	/rə'bɔt/	'work'
		-'a	/'ə/	'FEM NOM SG'
	unaccentable	gor-	/gɔr/	'mountain'

If an unmarked stem combines with an accented suffix, or an accented stem with an unmarked suffix, then the accent is realised on the lexically accented syllable, giving e.g. *golo'va* and *ra'boty*. Similarly, if an unaccentable stem (e.g. *gor-*) combines with an unmarked suffix, the suffix retains its accent, giving e.g. *go'ra*, to avoid violating the 'unaccentable' specification of the stem. That is, if there is only one lexically specified accent in a sequence of morphemes, that accent will be realised, as we might expect. If, however, both stem and suffix are accented, then the sequence has *two* lexically marked accents, as in *ra'bot* + *'a*. Under these circumstances, one accent is omitted, to give the realisation *ra'bota*. What happens if there are *no* lexical accents in a particular sequence? If two unmarked morphemes combine, the realisation of accent appears to be governed by a general rule stipulating that the default accent is word-initial, so that *golov* + *y* yields *'golovy*. Thus even a free-accent language such as Russian is subject to certain accentuation rules.

[17] Underlying /ɔ/ in Russian is realised as [ə] in unaccented syllables.

Returning now to English, we have distinguished two types of affix: **accent-neutral**, such as *-ly*, and what we might call **integrating** affixes, which are integrated into the domain to which they are attached, and thus considered to be part of that domain for the purposes of accent assignment. However, we can draw a further distinction within the set of integrating affixes. These may be either what we might call **accent-attracting** affixes, such as *-al* (38a), or **accent-bearing** affixes, such as *-ese* (38b):

(38) a. 'anecdote ˌanec'dotal
'incident ˌinci'dental
'universe ˌuni'versal
b. 'journal ˌjourna'lese
Tai'wan ˌTaiwa'nese[18]
'Java ˌJava'nese

Dutch has a set of prefixes which are accented when combined with verbs, as shown in (39):

(39) a. 'voeren 'to lead' 'opvoeren 'to perform'
'lossen 'to unload' 'oplossen 'to solve'
b. 'staan 'to stand' 'uitstaan 'to put up with'
ran'geren 'to shunt' 'uitrangeren 'to put out to grass'
c. 'keren 'to turn' 'omkeren 'to turn over'
'kopen 'to buy' 'omkopen 'to bribe'

Thus these prefixes are accent-bearing, and must be lexically marked as such; they override the accentual pattern of the original morpheme. However, they in turn must yield to the demands of certain other suffixes, as shown in (40), where the forms in (39) are combined with the adjectival suffix *-baar* '-able':

(40) a. op'voerbaar 'performable'
op'losbaar 'soluble'
b. onuit'staanbaar 'unbearable'
uitran'geerbaar 'able to be put out to grass'
c. om'keerbaar 'able to be turned over'
om'koopbaar 'bribable'

The suffix *-baar* attracts accent to the immediately preceding syllable, and obliterates the lexical accent of the prefixes in (40).

Having discussed affixation, we now turn to compounding. Members of compounds behave like independent domains for accent in many languages, although they may fuse into a single domain. In English, for example,

[18] The shift of the original accent of *Taiwan* to the first syllable is the result of a process which is independent of the fact that *-ese* is an accent-bearing affix (see §4.3.1 for further discussion).

compounds behave differently from phrases with respect to their accentuation: whereas phrases in English typically have a w s pattern, compounds show the reverse, s w. This results in accentual 'minimal pairs', familiar from the literature on accentuation, such as *a black 'board* 'a board which is black' vs *a 'blackboard* 'a board for writing on with chalk'; cf. *'greenfly* vs *green 'fly*, *'White House* vs *white 'house*, etc. In terms of the representation in (13), we need to add an extra grid layer to represent the compound accent, as in (41), the representation for *White House politics* /ˌwaɪt haʊs 'pɒlɪtɪks/:

(41)
(·		×		)	phrasal accent
(×	·)	(×		)	compound accent
(×)	(×)	(×		·)	word accent
(×)	(×)	(×	·)	(×)	foot accent
σ	σ	σ	σ	σ	
waɪt	haʊs	pɒ	lɪ	tɪks	

(Notice that the first syllable of *politics*, which is not a compound, is vacuously assigned an accent by the compound accent rule.)

The various phenomena which we have been considering – e.g. the preference for accents to fall at the edge of domains and the interaction between morphological structure and accent – have to be accounted for in some kind of formal theory of accent. Before we move on to this, though, let us consider the role of non-primary accents.

4.3.1 Non-primary accent

To what extent do the generalisations relating to the placement of primary accents apply to non-primary accents as well? As in the case of the primary accent, the position of the non-primary accent in many languages is rule-based. The simplest case is that in which these accents form an alternating pattern moving away from the primary accent. An example of a language with a system like this is Warao, spoken in Venezuela. Osborne (1966: 115) observes that in Warao 'alternate syllables are stressed with a weaker secondary stress, counting back from the strongly stressed syllable'. This is illustrated by the forms in (42):

(42) ko'ranu 'drink it!'
ˌkona'ruae 'carried away'
yiˌwara'nae 'he finished it'
ˌnahoˌroaˌhaku'tai 'the one who ate'
eˌnahoˌroaˌhaku'tai 'the one who caused him to eat'

In a system such as this, the syllables preceding the primary accent are gathered up into trochaic binary feet, with the first syllable of each foot

being assigned a secondary accent. If there is an odd number of syllables in the word, the initial syllable remains unfooted. This gives the following structure for *enahoroahakutai*:

(43)
```
(·     ·     ·     ×  )      word accent
(×  ·) (×  ·) (×  ·) (×  ·)   foot accent
σ  σ  σ  σ  σ  σ  σ  σ  σ
e  na ho ro a  ha ku ta i
```

Just as with primary accents, the placement of non-primary accents may be affected by morphological structure. In English compounds of the type *blackboard* and *petrol station*, the syllable of the second morpheme, which lexically bears primary accent, is realised with secondary accent when it forms a compound, as in (44), *petrol station* /ˈpɛtrəl ˌsteɪʃən/:

(44)
```
(×     ·  )   compound accent
(×  ) (×  )   word accent
(×  ·) (×  ·) foot accent
σ  σ  σ  σ
pɛ trəl steɪ ʃən
```

Thus, the location of non-primary accent in these compounds is dependent on the location of the primary accent in the units that they are composed of. This is generally also the case when words combine to form a phrase, which in English yields a w s pattern, as in *ˌNew ˈYork*, *ˌhard-ˈboiled*, *ˌRugby ˈUnion* and *ˌweight-ˈsensitive*. However, if such phrases are themselves part of compounds, we often encounter sequences which violate the principles of eurhythmicity discussed in §4.2, for example because two accented syllables are 'too close' after compounding, as illustrated by forms such as *New York pizza*, *hard-boiled egg*, *Rugby Union president* and *weight-sensitive stressing* in (45):

(45) ˌNew York ˈpizza
ˌhard-boiled ˈegg
ˌRugby Union ˈpresident
ˌweight-sensitive ˈstressing

Consider the bracketed grid corresponding to *New York pizza* /nju: jɔ:k pi:tsə/:

(46)
```
(     ·  ×     )   phrasal accent
(·    ×) (×    )   phrasal accent
(×)  (×) (×    )   word accent
(×)  (×) (×  ·)   foot accent
σ    σ  σ  σ
nju: jɔ:k pi: tsə
```


(Notice that the complete phrase is made up of two smaller phrases, *New York* and *pizza*, so that phrasal accents are assigned twice.) At the word-accent level the two rhythmic 'beats' corresponding to the primary word accents on *York* and *pizza* are adjacent, giving /nju: ˌjɔ:k ˈpi:tsə/, and thus display a **rhythmic clash**. Under these circumstances English allows the secondary stress to move to the first element of the phrase, by a process known as **stress shift**, to give the grid in (47):

(47)
```
(·     ×  )   phrasal accent
(×  ·) (×  )   phrasal accent and stress shift
(×)  (×) (×  )   word accent
(×)  (×) (×  ·)   foot accent
σ    σ  σ  σ
nju: jɔ:k pi: tsə
```

in which the strong and weak syllables display an alternating pattern.

This process is not restricted to phrases of which the first element is a compound. If the first element is a word in which a secondary accent precedes a primary accent, then it will also be available for stress shift, as shown in (48):

(48) ˌJapa'nese *but* ˌJapanese 'sushi
ˌMissis'sippi ˌMississippi 'madrigals
ˌseven'teen ˌseventeen 'sisters

Again we see that the original primary accent shifts to the place of the original secondary accent, and becomes subordinated to the primary accent of the righthand element of the whole phrase.

We will not pursue the details of stress shift here.[19] Rather, we turn to some examples from morphology which, like the compounding phenomena discussed above, demonstrate that primary accents of morphemes which lose their status as primary as a result of their being embedded may still be recognisable in surface realisations. Chomsky and Halle (1968: 116) consider the case of the two nouns *compensation* and *condensation*, which apparently have the same prosodic structure. Their morphological structures differ, however: the underlying representations of the verbs from which the nouns are derived is presumably as given in (49):

(49)
```
a. (×     ·)        b.   (×)      word accent
   (×  ·) (×)           (×) (×)    foot accent
   σ  σ  σ              σ  σ
   com pen sate         con dense
```

[19] There is an enormous literature on this phenomenon, much of which is concerned with the appropriate representation of stress shift. See e.g. Liberman and Prince (1977), Prince (1983), Hayes (1984a), Selkirk (1984a), Giegerich (1985) and, for an overview, Visch (1989).

'Compen,sate has primary accent on the initial and secondary accent on the final syllable; *con'dense* has primary accent on the final syllable. The vowel in the first syllable of *condense* is at least potentially not reduced to schwa, and therefore forms a foot. When suffixation of *-ation* or *-ion* takes place, primary accent moves to the first syllable of *-ation*, which is an accent-bearing suffix. As a result, the initial syllable of *condense* acquires secondary accent. We might assume, then, that the two words would have identical grid structures, as in (50):

(50)

a.	b.	
(· ×)	(· ×)	word accent
(× ·) (× ·)	(× ·) (× ·)	foot accent
σ σ σ σ	σ σ σ σ	
com pen sa tion	con den sa tion	

However, Chomsky and Halle observe that in many dialects of English the pronunciation of these two words differs in one crucial respect: whereas the second syllable of *compensation* contains a reduced schwa-type vowel, that of *condensation* has a full vowel. Thus in RP, the two words would be realised as /ˌkɒmpənˈseɪʃən/ and /ˌkɒndenˈseɪʃən/, respectively. Chomsky and Halle associate this difference with the fact that the second syllable of *condensation* originally bore a primary accent; the presence of the full vowel in the derived noun reflects its 'history'.

It might be possible to represent this syllable as bearing tertiary accent, as in (51):

(51)

a.	b.	
(· ×)	(· ×)	primary accent
(×) (×)	(× ·) (×)	secondary accent
(× ·) (× ·)	(×) (×) (× ·)	tertiary accent
σ σ σ σ	σ σ σ σ	
com pen sa tion	con den sa tion	

However, it is a moot point whether it is possible to distinguish more than two levels of accent, and we take no position on this matter here. Nevertheless, the discussion above has clearly shown that accents may be 'persistent'.[20]

4.4 Metrical theory

In §4.2 above, we suggested that accents prefer to occur at the edge of a foot, and that primary accents prefer to occur at the edge of a word. Nevertheless, we have also seen that there are languages such as Polish in which primary accent regularly falls on a non-peripheral syllable. In the case of Polish this is

[20] In traditional derivational phonology, this persistence is captured in terms of **cyclicity**: accent rules may apply cyclically to successive morphological domains. See e.g. Cole (1995) for a discussion of the cycle in phonology.

the penultimate syllable, but the full array of attested systems shows a wide range of possibilities, as shown in (52) (drawn partly from the inventory given by Hayes 1995):

(52)

initial	*postinitial*	
Finnish	Dakota	
Maranungku	Southern Paiute	
final	*penultimate*	*antepenultimate*
Tübatulabal	Polish	Macedonian
French	Warao	

Hyman (1977) identifies more cases of penultimate than initial primary stress, with final stress coming third. Postinitial and antepenultimate patterns are rare, and post-postinitial virtually unknown.

Initial and final accent could be accounted for by primary accent rules which identify the edges of the accentual domain. Such rules would construct the elementary metrical grids as in (53), i.e. grids with no internal bracketing:

(53)

a.	b.
(× · · · ·)	(· · · · ×)
σ σ σ σ σ	σ σ σ σ σ

But what about postinitial, penultimate and antepenultimate accent?

Notice first that there is an asymmetry between left-edge accent and right-edge accent. Whereas the latter seems to be able to reach the third syllable from the edge (as in Macedonian), post-postinitial accent is virtually never attested. Even though only a few examples of fixed antepenultimate accent have been recorded, it is frequently found in the exceptional vocabulary of languages which otherwise have fixed penultimate accent. A theory of accent placement must account not only for this asymmetry, but also for the fact that fixed patterns other than those in (53) are never found. If primary accent placement were unrestricted, in the sense that any syllable at some fixed distance from the word-edge could be reached, we would expect to find languages having accent on the fourth syllable from either the left or right edge, or even in the 'middle'.

We therefore need a mechanism for determining primary accent placement that excludes such non-occurring cases. This means that a system which simply allows us to indicate any syllable as potentially accentable is inadequate. For example, such a theory fails to account for the fact that words can have only one primary accent: there is nothing in the theory to prevent us from assigning an accent mark to the first *and* last syllables in (53), or indeed to every syllable in the word. The theory of accent placement proposed in Chomsky and Halle (1968) has much the same drawback. In their model, any vowel bears a segmental feature [±accent] (in their terms [±stress]), which is

formally identical to other segmental features such as [±round] and [±sonorant]. Here, too, there is no formal reason not to mark *all* the syllables in a word as [+accent], which would be in conflict with the culminative nature of accent.

A model which allows any syllable in a word to be accented also fails to account for the ways in which accent can exhibit its edge preference (i.e. its demarcative property; cf. §4.1). The grids in (53) are for the 'optimal' initial and final patterns; it seems just as easy to construct the grids in (54a–c) for the less common postinitial, penultimate and antepenultimate patterns, and indeed those in (54d–e) for the – at best – marginal post-postinitial pattern, and the apparently impossible pre-antepenultimate pattern:

(54) a. *postinitial*

```
(· × · · ·)
σ σ σ σ σ
```

b. *penultimate*

```
(· · · × ·)
σ σ σ σ σ
```

c. *antepenultimate*

```
(· · · × · ·)
σ σ σ σ σ σ
```

d. *post-postinitial*

```
(· · × · · ·)
σ σ σ σ σ σ
```

e. *pre-antepenultimate*

```
(· · · · × · · ·)
σ σ σ σ σ σ σ σ
```

Clearly, any theory which simply allows us to pick out any syllable within a word as accented fails to provide insight into the phenomena we have been considering, and so is inadequate as a theory of primary accent placement. Its inadequacy is emphasised when we consider further non-primary accents.

We have already seen that the distribution of non-primary accents is rule-based and non-random. Accentual patterns tend to show alternations between accented and non-accented syllables. Thus, as we saw in §4.3.1, accents on adjacent syllables (**clashes**) are avoided where possible, for example by stress-shift processes such as that of English. Equally, languages tend to avoid stretches of more than two unaccented syllables (**lapses**). At the lowest level of rhythmic organisation, then, languages have binary rhythmic patterns (55a) or ternary rhythmic patterns (55b), but not quaternary rhythm (55c):

(55) a.

```
(× ·) (× ·) (× ·) (× ·) (× ...
σ σ σ σ σ σ σ σ σ
```

b.

```
(× · ·) (× · ·) (× · ·) ...
σ σ σ σ σ σ σ σ σ
```

c. *

```
(× · · ·) (× · · ·) (×...
σ σ σ σ σ σ σ σ σ
```


In the previous section we suggested that rhythmic non-primary accents can be regarded as properties of a domain that is smaller than the word, which we called the foot. It would seem, then, that we must construct a set of algorithms for assigning foot structure. These form the central core of what is known as metrical theory, and we will turn to this in the next section. We will show that, although the languages of the world appear to display a great variety of accentual patterns, metrical theory requires only two rules for the placement of primary accent, one which places accent on the leftmost foot accent in a particular domain (56a), and one which places accent on the rightmost foot accent (56b):

(56) *Primary accent rules*

a. `× → × / __ )` foot accent

b. `× → × / ( __` foot accent

4.4.1 Metrical structures

In this section we examine how the various observations on word and foot structure in the previous sections can be formalised within metrical theory. Let us start by considering again the English word *Apalachicola*, introduced in §4.1. The six syllables of this word are organised into three trochaic feet, as in (57):

(57)

```
(× ·) (× ·) (× ·)        foot accent
σ σ σ σ σ σ
æ pə læ ʧɪ kɛʊ lə
```

How do we generate the structure in (57)? The metrical structure assigned to any word is the result of the setting of a number of **parameters**, which specify the choices available to a language with respect to some property. With respect to *Apalachicola*, which has initial primary accent and a rightward alternating rhythmic pattern, the two parameters in (58) determine the foot structure:

(58) *foot structure*

i. left-headed (i.e. the leftmost syllable of the foot is accented)
ii. assigned from right to left

(58.i) specifies that the foot structure of (57) is trochaic, i.e. it is the first syllable of the foot which is accented. Notice that (58.i) is formulated in terms of headedness; metrical theory makes use of headed tree structures, represented as bracketed grids. As in our account of syllable structure, headed trees embody the claim that each constituent contains just one 'central' unit, the **head**, and in addition one or more non-heads, the **dependents**. As we have

seen, the notion of head is central to the kind of structures that linguists posit in syntax, morphology and phonology.[21]

The use of headed structures, and more specifically the notion that each accent forms a head, guarantees that every domain has precisely one accent. In this way, we derive the property of culminativity of accent. The additional property that heads in metrical structure can only be located at edges of constituents expresses the demarcative function of accent (cf. §4.1).

(58.ii) specifies that the six syllables of *Apalachicola* are organised into feet, starting from the right. However, since the word *Apalachicola* has an even number of syllables, it does not itself provide evidence for (58.ii); left-to-right assignment would yield the same structure, given that we have specified the feet as trochaic. However, words with an odd number of syllables provide the necessary evidence, as is shown by a word such as *Mo,nonga'hela*, which has the foot structure in (59a). If feet had been assigned from the left, we would have the incorrect structure in (59b):

(59) a. (× ·)(× ·) b. * (× ·)(× ·) foot accent
σ σ σ σ σ σ σ σ σ σ
mə noŋ gə hiː lə mɔ nəŋ gæ hiː lə

Notice that the first syllable in (59a) is left unfooted, i.e. it is not parsed, but is 'stranded' (as before, unparsed syllables are not marked with a dot). Allowing stranded syllables implies that we do not require foot parsing to be exhaustive, i.e. that not all syllables have to be assigned to a foot. Such stranded syllables are sometimes characterised as forming a **degenerate** foot, but the question of how they are incorporated into metrical structure is a matter of some controversy, which we return to in §4.4.4.

After the assignment of foot structure by (58), *Apalachicola* will be assigned word accent by the parameter setting in (60):

(60) *word structure*
right-headed (i.e. the rightmost foot accent receives primary accent)

This gives the word structure in (61):

(61) (· · ×) word accent
(× ·)(× ·)(× ·) foot accent
σ σ σ σ σ σ
æ pə læ ʧɪ kɛʊ lə

In (61) we adopt a ternary structure at word-accent level; we assume that the first two feet are both 'weak', i.e. depend on the foot containing the primary accent, but that neither is stronger than the other.

[21] See Anderson and Ewen (1987), Halle and Vergnaud (1987a), Dresher and van der Hulst (1995, 1998) for discussions of the notion 'head' in phonological structure.

It is clear that the adoption of the parameter settings in (58) and (60) allows us to generate the correct accentual pattern for *Apalachicola*. It is easy to see that if we had chosen the opposite value for each of the parameters, we would have produced the incorrect structure in (62):

(62) (× · ·) word accent
(· ×)(· ×)(· ×) foot accent
σ σ σ σ σ σ
ə pæ lə ʧɪ kə læ

The structure in (62) would result from the application of a rule stating that the primary accent falls on the second syllable and secondary accents on every other syllable following the primary accent, yielding **A'pala,chico,la*.

More importantly, however, it is claimed that these settings are appropriate for English in general. That is, while (58) and (60) represent the choices for English, other languages differ in their settings for each of the parameters in (63), which gives the full set developed so far:

(63) a. *foot structure*
i. HEADSHIP: left-headed (LH) *or* right-headed (RH)
ii. DIRECTIONALITY: assigned from left to right (L→R) *or* right to left (R→L)
b. *word structure*
HEADSHIP: left-headed (LH) *or* right-headed (RH)

These parameters are in principle independent of each other. The parametric approach to accent was first proposed by Halle and Vergnaud (1978) and further developed and richly exemplified in Hayes (1981, 1995). One of its achievements has been to analyse the variety of attested accentual patterns in terms of a small set of parameters such as those in (63).

It is clear that, given the three binary parameters in (63), we might generate eight different types of accentual systems. The foot structure parameters give four possibilities; combined with the word headship parameter – left-headed or right-headed – this allows us to generate the eight systems in (64):

(64) a. Word (LH), Foot (LH, L→R)
b. Word (LH), Foot (RH, L→R)
c. Word (RH), Foot (LH, R→L)
d. Word (RH), Foot (RH, R→L)
e. Word (LH), Foot (LH, R→L)
f. Word (LH), Foot (RH, R→L)
g. Word (RH), Foot (LH, L→R)
h. Word (RH), Foot (RH, L→R)

However, although there are eight possible patterns, (64a–d) are significantly more common than those in (64e–h). (65) shows the structures generated by the four common patterns:

(65)

	odd number of syllables	*even number of syllables*
a. word (LH)	(× ·)	(× · ·)
foot	(× ·)(× ·)	(× ·)(× ·)(× ·)
(LH, L→R)	σ σ σ σ σ	σ σ σ σ σ σ
b. word (LH)	(× ·)	(× · ·)
foot	(· ×)(· ×)	(· ×)(· ×)(· ×)
(RH, L→R)	σ σ σ σ σ	σ σ σ σ σ σ
c. word (RH)	(· ×)	(· · ×)
foot	(× ·)(× ·)	(× ·)(× ·)(× ·)
(LH, R→L)	σ σ σ σ σ	σ σ σ σ σ σ
d. word (RH)	(· ×)	(· · ×)
foot	(· ×)(· ×)	(· ×)(· ×)(· ×)
(RH, R→L)	σ σ σ σ σ	σ σ σ σ σ σ

Kager (1995) gives examples of each of these systems: (65a) is that of Hungarian (see Kerek 1971), (65b) that of Araucanian (Echeverría and Contreras 1965), (65c) that of Warao (Osborne 1966) and (65d) that of Weri (Boxwell and Boxwell 1966).

We can observe a correlation in (65) between directionality and primary accent location. (a) and (b) display left-to-right parsing, with primary accent falling on the leftmost foot; in (c) and (d) we have right-to-left parsing, with primary accent falling on the rightmost foot. This appears to be typical of accentual systems, such that the head of the word is the foot which is closest to the edge from which the parsing begins. As noted by van der Hulst (1984), the systems in (66), in which this correlation is not found, are much less common, although they do occur:

(66)

	odd number of syllables	*even number of syllables*
a. word (RH)	(· ×)	(· · ×)
foot	(× ·)(× ·)	(× ·)(× ·)(× ·)
(LH, L→R)	σ σ σ σ σ	σ σ σ σ σ σ
b. word (RH)	(· ×)	(· · ×)
foot	(· ×)(· ×)	(· ×)(· ×)(· ×)
(RH, L→R)	σ σ σ σ σ	σ σ σ σ σ σ

c. word (LH)	(× ·)	(× · ·)
foot	(× ·)(× ·)	(× ·)(× ·)(× ·)
(LH, R→L)	σ σ σ σ σ	σ σ σ σ σ σ
d. word (LH)	(× ·)	(× · ·)
foot	(· ×)(· ×)	(· ×)(· ×)(· ×)
(RH, R→L)	σ σ σ σ σ	σ σ σ σ σ σ

Note that in systems of this kind the exact location of the primary accent is dependent on the number of syllables that the word is composed of.

The systems we have been considering are those involving trochaic and iambic feet only. We return in §4.4.5 to the analysis of dactylic feet, which we introduced in §4.2 above.

4.4.2 Weight-sensitivity

In our discussion of accent assignment, we have so far been ignoring the internal structure of the syllables which go to make up feet. However, we saw in §3.4.1 that in certain languages we can distinguish between 'heavy' and 'light' syllables. Under the appropriate circumstances, heavy syllables are capable of bearing accent, while light syllables are not. For example, Churchward (1940: 75) gives the following forms from Rotuman (an Austronesian language spoken on Rotuma, an island north of Fiji):

(67)

a.	'taka	'to lie'	b.	kara'ra:	'to snore'
	hunu'nuka	'to gasp'		ma'ro:	'to win'

The forms in (67) exemplify the Rotuman rule of accent placement in (68):

(68) Primary accent falls on the final syllable if this syllable contains a long vowel, otherwise it falls on the penultimate syllable.

Similarly, Yapese (Hayes 1981: 65–6) has the rule in (69):

(69) Primary accent falls on the penultimate syllable if the final is closed and the penultimate is open, otherwise it falls on the final syllable.

Accent rules that are sensitive to the structure of the syllables are often said to be quantity-sensitive, a term which suggests that the accent rule is primarily sensitive to length distinctions. However, as shown by (69), and as discussed in §3.4.1, the distinction between heavy and light syllables may also involve factors such as whether the syllable is open or closed. We will see below that quantity and closure are probably independent factors in the determination of weight, and that there are other accent-attracting properties which may also play a role. Hence we adopt here the more abstract term

weight-sensitive. Generally, only the two weight categories identified in §3.4.1 play a role in accent assignment: syllables are either heavy or light.

How, then, can our theory of foot assignment be enriched such that weight-sensitive systems can be accommodated? It is clear that systems are weight-sensitive whenever certain syllables (i.e. those that are heavy) are unable to occupy the dependent position in the foot, with the result that they always end up as the head of the foot.

Let us assume the **weight-sensitivity** parameter in (70):

(70) WEIGHT-SENSITIVITY: heavy syllables are unable to occupy the dependent position in a foot.

which can be set to 'yes' or 'no'. If the weight parameter is set to 'yes', then we must also establish what constitutes a heavy syllable in the language in question; i.e. are we dealing with a rhyme-weight language or a nucleus-weight language, as discussed in §3.4.1?

The introduction of the weight parameter means that we now have the set of parameters in (71):

(71) a. *foot structure*
- i. HEADSHIP: left-headed (LH) *or* right-headed (RH)
- ii. DIRECTIONALITY: assigned from left to right (L→R) *or* right to left (R→L)
- iii. WEIGHT-SENSITIVITY: yes *or* no

b. *word structure*
HEADSHIP: left-headed (LH) *or* right-headed (RH)

The addition of the weight-sensitivity parameter obviously doubles the number of different types of accent systems that can be generated. One such system is shown in (72):

(72) a. *foot structure:* LH, R→L, weight-sensitive
b. *word structure:* RH

Let us consider the system defined by (72). If we consider only the rightmost foot in the word, then there are four possible configurations, as shown in (73), where σ̄ represents a heavy syllable and σ̆ a light syllable:

(73) a. σ̄ σ̆ b. σ̆ σ̆ c. σ̄ σ̄ d. σ̄ σ̄

(73a) and (b) present no problem, since we can simply assign the final two syllables to a binary trochaic foot without violating the weight parameter, which prevents a heavy syllable from occurring in the dependent foot position. This gives the grids in (74):

(74) a. (× ·) b. (× ·) foot accent
σ̄ σ̆ σ̆ σ̆

Recall that the weight parameter bars heavy syllables from dependent position, but does not bar light syllables from head position, so that (74b) is well formed. However, we cannot construct a trochaic foot over the two word-final syllables (73c) and (d), because the final heavy syllable would then end up in the weak position of the foot. What we can do, however, is assign a monosyllabic foot to the final syllable only, giving the following representations for (73c) and (d):

(75) a. (×) b. (×) foot accent
σ̆ σ̄ σ̄ σ̄

In (c) and (d), the heavy syllable forms a foot by itself. The structures in (75) are appropriate for a system which has primary accent on the final syllable if this is heavy and on the penultimate syllable otherwise, i.e. the type represented by Rotuman in (68).

As we saw in (69), Yapese represents a second type of weight-sensitive system. In such systems, primary accent also falls on the final syllable in the (73b) case, i.e. if the last two syllables are both light. The simplest way of analysing such systems appears to be to assume that foot structure is iambic, rather than trochaic, i.e. that the parameter setting is as in (76):

(76) a. *foot structure:* RH, R→L, weight-sensitive
b. *word structure:* RH

This yields the foot structures in (77):

(77) a. (×) b. (· ×) c. (×) d. (×) foot accent
σ̆ σ̆ σ̆ σ̆ σ̆ σ̄ σ̄ σ̄

Notice that in (77a) we have not assigned the final light syllable to a foot. We assume that this reflects the following condition on foot structure:

(78) *Condition on foot size*
In weight-sensitive systems feet cannot consist of one light syllable.

4.4.3 Foot typology

It will be clear that the addition of the weight-sensitivity parameter means that we can generate sixteen possible accent systems. However, as we have already seen, by no means all of these systems actually occur in the languages of the world, and even the set of possible systems that we have already identified cannot combine freely with either setting of the weight-sensitivity parameter. For example, right-headed weight-insensitive feet systems are rare, and left-headed weight-sensitive systems with left-to-right foot assignment apparently

absent. These facts lead Hayes (1995: ch. 4) to assume a much more restricted inventory of basic metrical units, namely the **syllabic trochee**, the **moraic trochee** and the **iamb**. The inventory is given in (79) (from Hayes 1995: 71):

(79) a. *syllabic trochee* (× ·) / σ σ

b. *moraic trochee* (× ·) / σ̆ σ̆ *or* (×) / σ̄

c. *iamb* (· ×) / σ̆ σ *or* (×) / σ̄

On this analysis, then, weight-insensitive systems are normally left-headed, i.e. trochaic. Syllabic trochees are left-headed weight-insensitive feet, as shown in (80):

(80) a. (× ·) / σ σ b. (× ·) / σ σ σ

Syllables are gathered into left-headed binary feet, with any leftover syllables, as in (80b), remaining unparsed. A monosyllabic word may form a foot of its own, depending on the language in question (see §4.4.4 below). Hayes (1995: 188ff.), drawing his data from the analysis of Árnason (1985), cites Icelandic as an example of a syllabic trochaic system which allows monosyllabic words to form feet. Relevant forms are given in (81):[22]

(81)	'Jón	'John'
	'taska	'briefcase'
	'höfðing,ja	'chieftain (GEN PL)'
	'akva,rella	'aquarelle'
	'bíó,grafí,a	'biography'

However, Hayes believes that the final secondary accent in, for example, *'höfðing,ja* and *'bíó,grafí,a* should be assigned to phonetic lengthening rather than to metrical structure, and should therefore be disregarded in constructing the appropriate foot patterns, given in (82):

(82) a. (×) / σ / Jón b. (× ·) / σ σ / tas ka c. (× ·) / σ σ σ / höf ðing ja

d. (× ·)(× ·) / σ σ σ σ / ak va rel la e. (× ·)(× ·) / σ σ σ σ σ / bí ó gra fí a

[22] The accents on the vowels denote different vowel qualities in Icelandic orthography; they do not indicate tone or accent.

The foot types in (79b) are found in the analysis of weight-sensitive systems. In systems employing the **moraic trochee**, a foot may be formed either by a heavy syllable on its own or by two light syllables. As anticipated in our discussion of mora theory in §3.5, one heavy syllable is equivalent to two light syllables, in that both contain two moras, so that the two types in (79b) share the moraic structure in (83):

(83) (× ·) / μ μ

Thus a system such as (83) builds feet on the basis of moraic, rather than syllabic, structure. In moraic trochaic systems, feet consist of exactly two moras, as shown in (84):

(84) a. (× ·) / μ μ / σ̄ b. (× ·) / μ μ / σ̆ σ̆ c. (× ·) / μ μ μ / σ̄ σ̆ d. (× ·) / μ μ μ / σ̆ σ̆ σ̆

As in the case of the syllabic trochee, systems may allow a final light syllable, as in (84c, d), to remain unparsed; in moraic trochaic systems, however, a heavy syllable always forms a foot.

Hayes (1995: §6.1.4) analyses Wargamay, an Australian language spoken in North Queensland, as having a moraic trochaic system, assigned from right to left. In this language, syllables with a long vowel are heavy; all others are light. Relevant forms are given in (85):

(85)	'ma:l	'man'
	'bada	'dog'
	'mu:ba	'stone fish'
	'gi:baɽa	'fig tree'
	ga'gara	'dilly bag'
	'giɟa,wulu	'freshwater jewfish'

The appropriate patterns are given in (86):

(86) a. (× ·) / μ μ / σ̄ / ma:l b. (× ·) / μ μ / σ̆ σ̆ / ba da c. (× ·) / μ μ μ / σ̄ σ̆ / mu: ba d. (× ·)(× ·) / μ μ μ μ / σ̄ σ̆ σ̆ / gi: ba ɽa

e. (× ·) / μ μ μ / σ̆ σ̆ σ̆ / ga ga ra f. (× ·)(× ·) / μ μ μ μ / σ̆ σ̆ σ̆ σ̆ / gi ɟa wu lu

Initial light syllables, as in (86e), remain unparsed (degenerate feet are not permitted in Wargamay).[23] Notice that the analysis apparently generates an incorrect representation for (86d); we find *['gi:ˌbaɽa], with secondary accent on the second syllable, rather than the correct form, ['gi:baɽa]. Hayes attributes this to a destressing rule which has the effect of resolving a clash between two successive stressed syllables in Wargamay.

Like moraic trochaic systems, iambic systems distinguish between heavy and light syllables. In such systems, any syllable following a *light* syllable forms a foot with that syllable, and is its head. Any remaining heavy syllables form feet on their own; remaining light syllables are unparsed.

(87) a. (×) b. (· ×) c. (· ×) d. (· ×)
σ̄ σ̆ σ̆ σ̆ σ̄ σ̆ σ̆ σ̄

Cayuga, a Lake Iroquoian language, is analysed by Hayes as having an iambic system. He cites the data in (88):

(88) hẽna'to:was 'they are hunting'
ẽhẽna'to:wat 'they will hunt'
teweka'tawẽnye? 'I'm moving about'
ka'nesta? 'board'

These have the patterns in (89):

(89) a. (· ×)(×)
σ̆ σ̆ σ̄ σ̆
hẽ na to: was

b. (· ×)(· ×)
σ̆ σ̆ σ̆ σ̄ σ̆
ẽ hẽ na to: wat

c. (· ×)(· ×)(· ×)
σ̆ σ̆ σ̆ σ̆ σ̆ σ̆
te we ka ta wẽnye?

d. (· ×)
σ̆ σ̆ σ̆
ka ne sta?

4.4.4 *Degenerate feet*

We have seen that the footing procedures developed in the previous section often leave a syllable unparsed, or **stray**. In a syllabic trochaic system, any odd-numbered word will contain one such syllable, as shown in (80b) above, while in moraic trochaic and iambic systems, a light syllable may be stray ((84c) and (87d)). In these representations, we simply left the syllable unparsed, as in Icelandic *höfðingja* (82c), Wargamay *mu:ba* (86c) and *gagara* (86e) and Cayuga *kanesta?* (89d) (the stray syllable is underlined). However, in at least one case, in the syllabic trochaic system of Icelandic, we have assigned a single syllable, *Jón* (82a), to a foot, rather than leaving it unparsed.

[23] See §4.4.4 for further discussion of degenerate feet.

Feet formed in this way are referred to as **degenerate**, and are defined by Hayes (1995: 86) as the 'logically smallest possible foot' within each of the types of system defined above. He formalises the notion as in (90):

(90) *Degenerate feet*

a. *syllabic trochee*
(×)
σ

b. *moraic trochee*
(×)
μ
|
σ̄

c. *iamb*
(×)
σ̆

How do we know whether an otherwise unparsed syllable should form a degenerate foot or not? In the case of a monosyllabic word like Icelandic *Jón*, we might think that any monosyllabic content word must be able to form a foot on its own, and for many languages this is indeed the case, for all three types of system. Hayes provides an extensive list of such languages. However, he also provides a list of languages which do *not* allow degenerate feet. For example, Cairene Arabic, which has a moraic trochaic system, does not allow monosyllabic words consisting of a single light syllable. Languages which have such restrictions are said to display a **minimal word constraint**, such that each phonological word must consist of at least one non-degenerate foot.

We can also demonstrate that stray syllables in polysyllabic words do not form degenerate feet in these languages. Hayes discusses two forms in Cairene Arabic, '*kataba* 'he wrote' and *qat'tala* 'he killed'. The first syllable of *qat'tala* is heavy (CVC); all other syllables in the two forms are light. The footing and accenting of the two forms are shown in (91) (Hayes 1995: 90):

(91) a. (×)
(× ·)
σ̆ σ̆ σ̆
ka ta ba

b. (· ×)
(×)(× ·)
σ̄ σ̆ σ̆
qat ta la

The final syllable of *kataba* remains unparsed, and fails to form a degenerate foot. This is evidenced by the fact that it does not attract primary accent; compare this with *qattala*, containing two full moraic feet, where primary accent falls on the strong syllable of the foot *tala*.

Cairene Arabic, then, does not allow degenerate feet under any circumstances. Languages with a minimal word requirement, however, permit them in monosyllabic words. Even these languages, though, typically only display degenerate feet in what Hayes calls strong positions, i.e. 'when dominated by another grid mark', for example because an unparsed final syllable is subject

to a rule assigning primary accent to the last syllable in a word. This leads Hayes to treat the presence or absence of degenerate feet as being due to a parameter, which prohibits degenerate feet either completely (e.g. Cairene Arabic) or in weak positions (e.g. Icelandic).

4.4.5 Ternary feet

There are a number of languages which at first sight appear to be analysable as involving ternary feet, rather than binary feet of the sort we have been considering up to now. Key (1961: 149), for example, analyses the system of Cayuvava, a language spoken in Bolivia, as having the following rule:

(92) Stress occurs on the antepenultimate syllable and every third syllable preceding it.

The application of this rule is illustrated by the forms in (93), which exemplify the accentual patterns from two up to nine syllables (from Hayes 1995: 309):

(93)	'ẹne	'tail'
	'ʃakahe	'stomach'
	ki'hibere	'I ran'
	ari'uuʧa	'he came already'
	ˌʤihira'riama	'I must do'
	maˌrahaha'eiki	'their blankets'
	ikiˌtapare'repeha	'the water is clean'
	ˌʧaadiˌroboβu'ruruʧe	'ninety-nine'

The most appropriate way to incorporate such ternary patterns into our foot inventory would at first sight appear to be to add a new foot type to the inventory given in (79), viz. the **syllabic dactyl**, which would have the structure in (94):

(94) *syllabic dactyl*

```
(×  ·  ·)
σ  σ  σ
```

The incorporation of this foot type into our inventory would allow us to represent some of the forms in (93) as in (95), assuming right-to-left foot assignment:

(95) a.

```
(×  ·  ·)
σ  σ  σ  σ
ki  hi  be  re
```

b.

```
(×  ·  ·)(×  ·  ·)
σ  σ  σ  σ  σ  σ  σ  σ
i  ki  ta  pa  re  re  pe  ha
```

c.

```
(×  ·  ·)(×  ·  ·)(×  ·  ·)
σ  σ  σ  σ  σ  σ  σ  σ  σ
ʧa  a  di  ro  bo  βu  ru  ru  ʧe
```


Dresher and Lahiri (1991) argue for the introduction of a rather different type of foot, which they call the 'Germanic foot', in order to account for the phenomenon of High Vowel Deletion in Old English which we examined briefly in §3.7.4. There we saw that the vowels /i/ and /u/ delete when they follow a heavy syllable (VC, VV) but not a light syllable (V). However, they also delete when they follow *two* light syllables, as shown in (96):

(96) a.

singular	*plural*	
scip	scipu	'ship'
lim	limu	'limb'
word	word	'word'
bān	bān	'bone'

b. we(o)rod < Early West Saxon */wered-u/ 'troops'
færeld < *færeldu 'journey'

Dresher and Lahiri suggest that these facts can be accounted for by postulating a **moraic dactyl** (their 'Germanic foot'), with the structure in (97):

(97) *moraic dactyl*

```
(×  ·)
 |
μ  μ  μ
```

Thus the strong branch of the foot must contain two moras. High Vowel Deletion, then, can only take place when the high vowel occupies an open syllable in the weak position of the foot. A word such as *scipu* contains two light syllables and therefore only two moras, so that the high vowel 'is required to form the strong branch' of the foot, and is not subject to deletion, as shown in (98a). Forms which do allow deletion, such as those in (98b, c), already have two moras in the strong branch, and so High Vowel Deletion is free to apply:

(98) a.

```
(×  )
 |
μ  μ
sci  pu
```

b.

```
(×  ·)
 |  |
μ  μ  μ
wo  rd  u
        ↓
        ∅
```

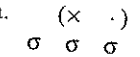
c.

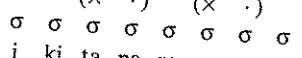
```
(×  ·)
 |  |
μ  μ  μ
fæ  reld  u
          ↓
          ∅
```

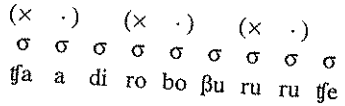
However, Hayes (1995: 307) observes: 'Much recent theorizing in generative grammar focuses on the idea of locality: we obtain interesting and valid predictions by constraining rules to apply within bounded domains. In phonology, the principle of locality often takes the form of limiting what can be counted: a reasonable conjecture is that phonological rules can count only to two.' In other words, it seems preferable to attempt to analyse systems such

as that of Cayuvava in terms of the binary foot inventory already established, rather than introducing dactylic feet, in which the principle of locality is necessarily violated, and whose presence in our inventory would lead to an enormous expansion in the generative capacity of the model.

Hayes reanalyses the apparently ternary system of Cayuvava in terms of syllabic trochees by appealing to the notion of **weak local parsing**. Whereas unmarked systems parse sequences into feet by simply moving from a parsed sequence to the immediately adjacent syllable, weak local parsing skips over a syllable after a foot is assigned. This means that in Cayuvava we assign syllabic trochaic feet, with an intervening unparsed syllable between each foot (final syllables are unparsed for reasons of extrametricality; see §4.4.7 below):

(99) a.


b.


c.


On this analysis, then, ternary feet do not form part of the inventory of possible feet types.

4.4.6 *Unbounded feet*

In all the systems which we have considered so far, we have found evidence for dividing up the syllables of a word into bounded feet. Such systems typically display an alternating accentual pattern. However, there exist systems in which it seems we can provide a more appropriate analysis in terms of **unbounded feet**. These are systems in which 'stress can fall an unlimited distance from a boundary or another stress, provided the appropriate conditions are met' (Hayes 1995: 32). Unlike bounded systems, then, accents do not tend to be equidistant from each other throughout the word; rather, we find systems such as that of Classical Arabic in (100) (from McCarthy 1979: 460):

(100) a. ki'taabun 'book (NOM SG)'
manaa'diilu 'kerchiefs (NOM)'
juʃaariku 'he participates'
b. 'mamlakatun 'kingdom (NOM SG)'
'kataba 'he wrote'
'balaħatun 'date (NOM SG)'

Accentuation in this system is determined by two rules, given by McCarthy as (101):[24]

(101) a. Stress the rightmost non-final heavy syllable.
b. Otherwise stress the first syllable.

Such a pattern is typical of unbounded systems. Two principles are involved; one which assigns the accent to a heavy syllable at a word-edge, and another which operates in the absence of a heavy syllable, which assigns the accent to some other word-edge syllable. The two principles may or may not target the same word-edge. In the Classical Arabic example in (100), opposite word-edges are selected, but Hayes (1995: §7.2) shows that all combinations are found. Thus Aguacatec, a Mayan language spoken in Guatemala, has the system in (102):

(102) a. Stress the rightmost heavy syllable.
b. Otherwise stress the final syllable.

This is illustrated by the forms in (103) (from McArthur and McArthur 1956); heavy syllables are those with a long vowel:

(103) a. 'haːlu? 'today'
'ʔeɪq'um 'carrier'
b. q'us'q'uh 'delicious'
k'olč'bil 'seat'

Amele, a Gum language spoken in Papua New Guinea, shows the same pattern as Aguacatec, but selects the opposite word-edge for both parameters, as shown by the data in (104) (from Roberts 1987: 358); heavy syllables are closed:

(104) a. du'æn 'cold'
gædo'loh 'edge'
'æn.se 'left hand'
b. 'mælə 'chicken'
'nɪfulə 'species of beetle'

Hayes (1995: 297) cites Kwakwala as an example of a language with the fourth possibility; i.e. accent on the first heavy syllable, otherwise on the final syllable.

Instead of approaching the systems discussed here in terms of unbounded foot structure, we might adopt the point of view that these languages have no foot structure at all, thereby allowing us to claim that feet are maximally binary. In such languages, word accent must be derived solely from weight,

[24] We ignore here 'superheavy' final syllables, which attract accent.

such that the leftmost or rightmost heavy syllable is assigned the word accent. In a word which has no heavy syllables, accent is assigned by default, usually to the first or last syllable within the word. There are four possible patterns: (i) rightmost heavy, default left (i.e. the final heavy syllable is accented, but if there is no heavy syllable in the word, accent falls on the initial syllable); (ii) rightmost heavy, default right; (iii) leftmost heavy, default left; (iv) leftmost heavy, default right (see Hayes 1995: 296–297; Goldsmith 1990: 180ff.). There are also languages with unbounded feet in which accent is assigned lexically, rather than by, for example, syllable weight. When two accented morphemes combine, factors such as the above also come into play, so that either the rightmost or the leftmost lexical accent is selected as the word accent. If neither morpheme is lexically accented, then a default rule will assign word accent to the leftmost or rightmost syllable, so that four patterns are again possible (see van der Hulst 1997, and cf. our discussion of Russian in §4.3).

4.4.7 *Extrametricality*

In §4.4.5 we examined evidence which showed that apparently ternary feet could be reanalysed by what Hayes terms 'weak local parsing'. In effect, in languages in which accent falls on every third syllable, a polysyllabic sequence was analysed as ('σ σ) σ ('σ σ) σ ('σ σ) σ, so that between each binary trochaic foot a syllable was left unparsed. However, the final syllable in such sequences is not subject to weak local parsing, as it is not intermediate between two accents. If we are to maintain the claim that there are no dactylic, i.e. ternary, feet, we must provide an account of the status of such final syllables.

At first sight, there appear to be many languages which have a simple rule which assigns primary accent to the antepenultimate syllable. We might therefore argue that in these cases accent location is the result of assigning a ternary foot at the right edge of the word, as in (105):

(105) ... (× · ·)
σ σ σ σ σ σ

However, a closer look at such systems suggests that, as before, it is not appropriate to postulate such dactylic feet. Accent assignment patterns such as that in (106) are frequently encountered:

(106) Primary accent falls on the penultimate syllable if it is heavy; otherwise it falls on the antepenultimate.

This is largely the system of Classical Latin, in which main stress *never* falls on the final syllable, whether it is heavy or light. In other words, it is simply

ignored, so that syllables which 'do not count' in the assignment of stress are considered to be **extrametrical**. This is illustrated in (107), for the words *amicus* /a'mi:kus/ 'friend', *tenebrae* /'tenɛbre:/ 'darkness', *domesticus* /do'mɛstikus/ 'domestic' (adapted from Hayes 1995: 92); heavy rhymes are VC and VV. Like extrasyllabicity in §3.4.4 (see also below), extrametricality is indicated by angle brackets:

(107) a. (×)
σ̆ σ̄ <σ̄>
a mi: kus

b. (× ·)
σ̆ σ̆ <σ̄>
tɛ nɛ bre:

c. (×)
σ̆ σ̄ σ̆ <σ̄>
do mɛs ti kus

The final syllable plays no part in accent assignment, which creates trochees from right to left.

In the examples in (107), the final syllable is made extrametrical. There is ample evidence that other types of units can be ignored in the application of rules, and therefore must be made extrametrical. Thus we saw in §3.8 that a consonant in the rhyme of a word-final syllable is often ignored for the purposes of computing syllable weight. In general, for a word-final syllable to count as heavy in a particular language, it often has to be heavier than a non-final syllable. For example, in a language in which a VC rhyme is heavy, a word-final VC rhyme may count as light. In this respect, consider the English nouns in (108):

(108) a. ... V<σ>
algebra

b. ... VC<σ>
agenda

c. ... VV<σ>
arena

Accent placement in these nouns is subject to the extrametricality parameter in (109), so that accent falls on the penultimate syllable if it is heavy (i.e. in English VC or VV), and otherwise on the antepenult:

(109) *Extrametricality parameter*
Ignore the final syllable (nouns)

Observe now that the rule governing accent placement in these nouns appears to be similar to that for the verbs considered in §3.8, and repeated as (110):

(110) a. ... VC
astonish

b. ... VCC
collapse

c. ... VVC
maintain

Here the final syllable is *not* declared extrametrical, and is therefore available for accentuation. This means that in (110) accent should fall on the final syllable if its rhyme is heavy, and on the penultimate otherwise. At first sight, though, all the verbs in (110) appear to have final syllables in which the rhyme is heavy or indeed superheavy. However, as we saw briefly in §3.8, the generalisation can be maintained if the final consonant of the verbs is

considered extrasyllabic (or indeed to be the onset of a following syllable), as in (111):

(111) a. . . . V<C> astonish b. . . . VC<C> collapse c. . . . VV<C> maintain

Now we have the familiar distinction between V (light) and VC/VV (heavy), and the rule applies as expected.

Consonant extrasyllabicity and syllable extrametricality are instantiations of the more general phenomenon of **constituent extrametricality**, which Hayes (1995: 57) suggests may be extended to other constituents, such as the foot or the phonological word. As Vergnaud and Halle (1978) point out, extrametricality is a parametric option in accentual patterns. Furthermore, it is generally restricted to peripheral constituents, i.e. those which occur at the edge of some domain; Hayes claims that the 'unmarked edge for extrametricality is the right edge', as in the cases we have examined so far.

The accentual system of English shows a number of parallels with that of Latin. Consider again some of the English data introduced in §3.8. The appropriate settings for the parameters in (71) will yield the word trees in (112) for *astonish*, *collapse* and *maintain*, respectively:

(112) a. (× ·) / σ̆ σ̄ σ̆ / ə stɒ nɪ <ʃ> b. (×) / σ̆ σ̄ / kə læp<s> c. (×) (×) / σ̄ σ̄ / meɪn teɪ<n>

Exactly the same parameter settings apply to generate the stress patterns of nouns such as *algebra*, *agenda* and *arena*, provided that we ignore the final syllable, rather than just the final consonant:

(113) a. (× ·) / σ̄ σ̆ <σ̆> / æl ʤə brə b. (×) / σ̆ σ̄ <σ̆> / ə ʤen də c. (×) / σ̆ σ̄ <σ̆> / ə ri: nə

The final syllable in the examples in (113), then, is extrametrical, and is ignored by virtue of the appropriate setting of the **extrametricality** parameter. Extrametricality, then, applied to word accentual patterns, offers a means of placing an accent three syllables away from the edge, while maintaining an analysis in terms of binary feet. Thus (105), the characterisation of antepenultimate accent, can better be represented as (114):

(114) ... (× ·) / σ σ σ σ σ <σ>

Notice finally that under certain circumstances, only particular *types* of syllable may be considered extrametrical for some process. In Dutch, for

example, trisyllabic words with a final heavy syllable have regular antepenultimate accent (van der Hulst 1984; Kager *et al.* 1985): *'albatros* 'albatross', *'horizon* 'horizon', *'hospita* 'landlady', *'pagina* 'page'. In these cases, then, it might be argued that the final syllable is extrametrical (but see the discussion in the next section). However, other trisyllabic words do not regularly have antepenultimate stress, e.g. *bal'lade* 'ballad', with a final light syllable, and *kapi'tein* 'captain', with a final superheavy syllable. Thus, the light syllable in (115b) and the superheavy syllable in (115c) are not extrametrical, unlike the heavy one in (115a):

(115) a. (× ·) / σ̄ σ̄ <σ̄> / pa: ɣi: na: b. (× ·) / σ̄ σ̄ σ̆ / ba: la: də c. (× ·)(×) / σ̄ σ̄ σ̿ / ka: pi: teɪn

(where σ̿ represents a superheavy syllable).

4.5 English and Dutch compared

We conclude this chapter with a brief examination of two systems of word accentuation which can be shown to be very similar in terms of the parameter settings which they select, even though the patterns which we encounter appear superficially to be very different. We base this on Trommelen and Zonneveld (1999: §§8.1.1–2), which is part of the general account of accentual systems in van der Hulst (1999), but we do not follow their analysis in all aspects.

Trommelen and Zonneveld give the following list of English and Dutch cognates:

(116)

	English		*Dutch*	
a.	family	['fæməlɪ]	familie	[fa:'mi:li:]
	Goliath	[gəʊ'laɪəθ]	Goliath	['ɣo:li:ɑt]
	balance	['bæləns]	balans	[ba:'lɑns]
	president	['prɛzədənt]	president	[pre:zi:'dɛnt]
	antecedent	[æntə'si:dənt]	antecedent	[ɑntəsə'dɛnt]
b.	libido	[lɪ'bi:dəʊ]	libido	['li:bi:do:]
	violet	['vaɪələt]	violet	[vi:o:'lɛt]

In each of these pairs, the primary accent falls on different syllables in the two languages. Nevertheless, Trommelen and Zonneveld argue, the set of parameters assigning accent is identical, although, as we shall see, there are many differences of detail:

(117) a. *final extrametricality:* yes
b. *foot structure:* bounded, LH, R→L, weight-sensitive
c. *word structure:* RH

Given these parameter settings, accent assignment to the English forms in (116) is straightforward, and proceeds in the same way as the forms considered in §4.4.6. In all cases, the final syllable is ignored (by (117a)). Weight-sensitive feet are constructed, starting from the right; the left branch of a binary foot is the head. The rightmost foot-head is selected as the head of the word, as shown in (118) for *ante'cedent*:

(118) (· ×)
(× ·)(×)
σ̆ σ̆ σ̄ <σ̄>
æn tə si: dənt

The two systems differ in two important respects. The first concerns the definition of syllable weight. For English, VV and VC rhymes are heavy and V rhymes are light; Dutch is similar, but, as we saw in §3.4.1, differs in treating VV rhymes as light, as is evidenced by the accentual patterns in (119), from Trommelen and Zonneveld (1999: §8.1.2.2):

(119)	a.	elektron	[e:'lɛktrɔn]	'electron'
		Agamemnon	[a:ɣa:'mɛmnɔn]	'Agamemnon'
		rododendron	[ro:do:'dɛndrɔn]	'rhododendron'
	b.	alfabet	['ɑlfa:bɛt]	'alphabet'
		Pythagoras	[pi:'ta:ɣo:rɑs]	'Pythagoras'
		Jeruzalem	[je:'ru:za:lɛm]	'Jerusalem'

In (119a) the penultimate rhyme is VC, and therefore heavy; in (119b) it is VV, and behaves as light in rejecting accent.

In all the cases in (119), it looks as if the final VC syllable is extrametrical, as we suggested in the previous section. This is supported by the forms in (120), with a VC penult and a VV final syllable, with penultimate accent:

(120)	Toronto	[to:'rɔnto:]	'Toronto'
	Casablanca	[ka:sa:'blɑŋka:]	'Casablanca'
	influenza	[ɪnflu:'enza:]	'influenza'

However, the forms in (120) are in fact neutral between an analysis in which the final syllable is treated as extrametrical and one in which the final two syllables are considered to form a binary left-headed foot, on the assumption that VV syllables are light. That this is not a trivial point is demonstrated by the two sets of words in (121), both of which end in two open syllables. Those in (121a), with penultimate accent, represent the regular pattern for Dutch words of this type; those in (121b), with antepenultimate accent, the irregular, but quite common, pattern:

(121)	a.	familie	[fa:'mi:li:]	'family'
		pijama	[pi:'ja:ma:]	'pyjamas'
		macaroni	[ma:ka:'ro:ni:]	'macaroni'
		hypotenusa	[hi:po:te:'nu:za:]	'hypotenuse'
	b.	libido	['li:bi:do:]	'libido'
		tombola	['tɔmbo:la:]	'tombola'
		Amerika	[a:'me:ri:ka:]	'America'
		Paramaribo	[pa:ra:'ma:ri:bo:]	'Paramaribo'

Given that (121a) represents the regular pattern, and that the forms in (119) appear to provide evidence that VV is light in Dutch, an analysis in terms of final extrametricality would seem inappropriate. Such an analysis would give the following structure for *familie*:

(122) (× ·)
σ̆ σ̄ <σ̄>
fa: mi: li:

This would incorrectly yield accent on the antepenultimate, which is the *irregular* pattern instantiated in (121b). Rather, a footing algorithm which treats the final two syllables of *familie* as a foot, as in (123), seems preferable:

(123) (× ·)
σ̆ σ̆ σ̆
fa: mi: li:

How can we arrive at the structure in (123)? Let us assume that the regular patterns of Dutch do *not* display extrametricality. Rather, a final VC syllable, which, recall, is heavy, will form a foot, while a light VV syllable does not. This gives the footing in (124):

(124)	a. ...VV.VV	b. ...VC.VV	c. ...VC.VC	d. ...VV.VC
	(× ·)	(× ·)	(×)(×)	(× ·)(×)
	σ̆ σ̆ σ̆	σ̆ σ̄ σ̆	σ̆ σ̄ σ̄	σ̄ σ̆ σ̄
	fa: mi: li:	to: rɔn to:	e: lɛktrɔn	ɑl fa: bɛt

On this analysis, final heavy syllables form feet, while final light syllables do not. This in turn means that the parameter in (117c) (word structure: RH) must be modified. Following the ideas outlined in van der Hulst (1984: ch. 5), we assume the following formulation:

(125) *word structure:* RH iff the final foot branches; otherwise LH

This modification is required to prevent forms such as *elektron* and *alfabet* from being assigned final accent, while still allowing the final foot of e.g. *karbo'nade* 'chop' to take accent:

(126) a. (×) b. (×) c. (× ·) d. (× ·)
(× ·) (× ·) (×) (×) (× ·) (×)
σ̆ σ̆ σ̆ σ̄ σ̄ σ̆ σ̆ σ̆ σ̄ σ̄ σ̆ σ̄
fa: mi: li: to: rɔn to: e: lɛktrɔn ɑl fa: bɛt

e. (· ×)
(× ·) (× ·)
σ̆ σ̆ σ̆ σ̆
kɑr bo: na: də

Because the final foot of *karbonade* contains two syllables, and is therefore branching, it takes primary accent.

There are two other circumstances under which primary accent falls on the final foot. The first involves final superheavy syllables, already discussed in §4.4.7. These are invariably accented, as shown in (127):

(127) kapitein [ka:pi:'tɛin] 'captain'
abrikoos [a:bri:'ko:s] 'apricot'
ledikant [le:di:'kɑnt] 'bedstead'

Clearly, (125) would fail to assign accent to the final foot, which is non-branching. We could generate the correct accentual pattern simply by stipulating that a final foot formed by a superheavy syllable is accented, but this would be unfortunate; it seems reasonable to assume that their ability to be accented is a product of the fact that they are inherently heavier than other syllables. In a mora-based analysis (cf. the discussion in §3.5), a superheavy syllable would contain more moras than a heavy syllable, and might therefore be interpretable as equivalent to a sequence of two 'normal' syllables. Here we follow the proposals of Langeweg (1988) and Zonneveld (1993), who suggest that superheavy syllables are underlyingly disyllabic, with the second syllable containing an empty nucleus. Thus a foot containing a superheavy syllable is branching, as shown in (128):

(128) a. (· ×) b. (· ×)
(× ·) (× ·) (× ·) (× ·)
σ̆ σ̆ σ̆ σ̆ σ̆ σ̆ σ̄ σ̆
a: bri: ko: sø le: di: kɑn tø

This account, reminiscent of aspects of the theory of government phonology discussed in §3.8, thus treats words with final superheavies as having the same structure as, for example, *karbonade*, with the only difference lying in whether the final nucleus is realised or not.

This account, as we have noted, is to be preferred to one in which final superheavies are simply stipulated as being accented, in that it attributes their

behaviour to their structure. However, no such account seems available for the other category of words which take final accent, illustrated in (116b):

(129) violet [vi:o:'lɛt] 'violet'
parasol [pa:ra:'sɔl] 'sunshade'
maniak [ma:ni:'ɑk] 'maniac'

The structure of the final syllable is no different from regular cases such as *alfabet*, with antepenultimate accent, and so it seems that the forms in (129) must simply be lexically marked as taking primary accent on the final syllable.

We return now to the irregular forms in (121b), such as *libido* and *tombola*, with antepenultimate instead of the expected penultimate accent. In these cases it seems that an appeal to extrametricality *is* appropriate; the final syllable must be lexically specified as being extrametrical, so that the penultimate light syllable will be footed with the antepenult:

(130) a. (× ·) b. (× ·)
σ̆ σ̆ <σ̆> σ̆ σ̆ σ̆ <σ̆>
li: bi: do: a: me: ri: ka:

The analysis of Dutch which we have given, then, involves the following parameter setting (cf. the setting for English in (117)):

(131) a. *final extrametricality:* no (except lexically)
b. *foot structure:* bounded, LH, R→L, weight-sensitive
c. *word structure:* RH iff the final foot branches; otherwise LH

4.6 Summary

In this final chapter we have examined the prosodic structure of the 'word' above the level of the syllable, and we have shown that syllables can be grouped into feet, which, in turn, form the (phonological) word. The chief exponent of the prosodic organisation of syllables into feet and words is accent or stress. In §4.1 we discussed the concept of word accent and its relation to intonation, while §4.2 introduced the notion of the foot. In §4.3 we considered the ways in which accent systems can vary, in particular in terms of the predictability of accent location, both primary and non-primary. §4.4 was concerned with the typology of feet found in the languages of the world, couched within the approach to phonological structure known as metrical phonology. The development of this typology allowed us to provide a comparative analysis of word accent in English and Dutch in §4.5.

4.7 Epilogue: levels and derivations

In this book we have been concerned with theories of phonological representation. As we noted in the preface, this is only one aspect of phonological theory in general. A theory of phonology can be seen as comprising three parts (cf. Goldsmith 1993): a theory of levels (e.g. lexical, phonological, phonetic), a theory of representations (for each level) and a theory of the relationship or mapping between levels.

In *SPE*, there was a clear distinction between what was often called the lexical and the phonological levels. The former contained unspecified features, as well as features marked with 'm' and 'u' or with '+' and '–'. Features at the phonological level had to be fully specified, in terms of '+' and '–' values only (cf. Kaye 1995). In this book we have assumed that there is no real distinction between the lexical and the phonological levels, and have made no distinction between rules that fill in feature-values or unary features and rules that modify the representation. Thus we assume that there is a single phonological input level, which reflects the consequences of setting parameters on units and on the ways in which they can combine at each phonological layer in the hierarchy. This level is affected by a set of rules that fill in, spread and remove feature-values. The phonological operations are sometimes stated as language-specific rules, while in other cases they follow from universal conventions, possibly in response to parameter settings. This view creates a distinction between an initial or phonological **input** level and a final or **output** level. The need for performing phonological operations that create this distinction comes from the idea that the initial phonological level abstracts away from redundancy (properties that are predictable, such as the scope or presence of a feature) and from productive allomorphic alternations (positing an invariant input that loses or acquires certain features in certain contexts).

In *SPE*, the operations (phonological rules) were extrinsically ordered. Extrinsic rule ordering creates *intermediate* levels between the input and output levels. Furthermore, this theory claims that the input and the intermediate levels differ *in kind* from the output level referring to the former as phonological and the latter as phonetic. In fact, it is claimed that the phonetic representations are different in kind, in that they allow the scalar specification of certain features (cf. Kaye 1995).

In our exposition we have not mentioned cases of extrinsic ordering of phonological rules or operations. Although the issue has not been addressed explicitly, we believe, in common with most current theorists, that extrinsic ordering is not necessary in phonology. Thus we do not envisage intermediate levels. Furthermore, we have not adopted the point of view that the final

or output level is in any sense less phonological than the initial or input level. Rather, we have assumed that the output level of phonology is not different in kind from the input level.

In fact, since there is no difference in kind between input and output, we prefer to refer to the input and output 'levels' as 'representations characterising a *single* level', i.e. the phonological level. We prefer to reserve the term 'level' for representations (or sets of representations) which differ in their representational vocabulary. Thus we might identify the phonological level, the phonetic level, the morphological (or morpho-syntactic) level and other possible levels outside the domain of phonology.

The phonological output representation should contain all information necessary to derive a phonetic interpretation, but the nature of the resulting phonetic level (however it is represented in a particular model) has not been our consideration, nor has been the mapping between the phonological and the phonetic levels. This mapping is not a trivial matter, however, because the phonological level *is* qualitatively distinct from the phonetic level, in the sense that the latter is a direct representation of articulatory or acoustic events. With this understanding of the relationship between the phonological and the phonetic levels, we have in this book been considering the nature of representations at the phonological level, and have drawn a distinction between an input and output representation, the latter resulting from the application of an unordered set of phonological operations or rules.

The relation between input and output representation at the phonological level can be seen as a function F, which maps one representation onto the other. If we disregard the fact that in *SPE* the input and output levels were assumed to be different in kind (cf. above), we can say that in this model the mapping function F was an ordered set of rules. In our book the content of this function F is an *unordered* set of rules and conventions. Other views are possible, and one, developed in Optimality Theory (OT; see for an introduction Kager 1999) has become very influential in recent times. Instead of rules which modify an input representation, OT proposes that the correct output for any input is selected from an infinite set of possible outputs, by an extrinsically ordered set of universal constraints.

In our view, the central claim of OT is largely orthogonal to the issues of levels and representations which we have discussed in this book. However, some optimality theorists would disagree, claiming that OT does not need a theory of representations or parameters to account for cross-linguistic differences. Rather, to exclude output 'candidates' with representations that contain combinations of phonological entities which are never found in languages, OT postulates a set of universally highly ranked constraints, which in

effect characterise the set of possible phonological representations. Generally, though, these constraints are not spelled out. In practice, it seems to us that OT analyses make implicit assumptions about the structure of phonological representations which are drawn from the repertoire of views such as those that we have discussed in this book. What remains as a more crucial difference between the view taken in this book and OT lies in the treatment of the kind of cross-linguistic differences that we have called parametric. OT replaces parameter setting by constraint ranking. The typical OT constraint in some sense functions as a 'unary parameter', which cannot be turned off, but instead must be dominated by another unary constraint, whose effect is to make the original constraint inapplicable.

We believe, then, that any phonological theory must have a coherent view of phonological representation. We hope that we have persuaded the reader of this book that this is indeed so, and that we have succeeded in showing that the phonological structure of the word remains a fertile area for the formulation of theories of phonological representation.

4.8 Further reading

On accent systems (§4.1), see Bolinger (1972), Hyman (1977), Schane (1979), Goldsmith (1982) and Beckman (1986). The relation between accent and its exponents is discussed by Lehiste (1970), van Heuven and Sluijter (1996) and Dogil (1999). Accounts of Japanese accentuation are given by Haraguchi (1977), Beckman and Pierrehumbert (1986), Pierrehumbert and Beckman (1988). On pitch-accent systems, see the papers in van der Hulst and Smith (1988b), as well as Bruce and Hermans (1999), Dogil (1999), Hualde (1999). Intonation is dealt with in Pierrehumbert (1980), Bolinger (1986), Ladd (1996), Cruttenden (1997) and Gussenhoven and Bruce (1999). On clitics, see Anderson (1996) and Nespor (1999).

On the foot as a unit of timing (§4.2), see Abercrombie (1964) and Catford (1977). Kiparsky and Youmans (1989) contains papers on metre; see for example Hayes (1989b). See also Hanson and Kiparsky (1996). The distinction between stress-timed and syllable-timed languages is due to Pike (1943). See also Dauer (1983), Selkirk (1984a) and Nespor and Vogel (1989). General works on the foot include C. Rice (1992), Kager (1993), Hayes (1995) and van der Hulst (1997).

For work on the typology of stress and accent systems (§4.3), see Haraguchi (1977), Hyman (1977), Halle and Vergnaud (1987a), Hayes (1995). The relationship between primary and non-primary accent is dealt with by van der Hulst (1984), Roca (1986), Hurch (1996) and van de Vijver (1998). On the

cycle in phonology, see Kean (1974), Kiparsky (1979), Halle and Vergnaud (1987b) and Cole (1995).

For the principles and history of metrical theory, and its notation (§§4.4, 4.4.1), see Liberman (1975), Liberman and Prince (1977), Halle and Vergnaud (1978), Kiparsky (1979), Prince (1980, 1983), Hayes (1981), Giegerich (1985), Levin (1985), Hogg and McCully (1987), Goldsmith (1990), Halle (1990), Halle and Idsardi (1995) and Kager (1995).

On foot typology and related matters (§§4.4.3–4.4.7), see many of the above references, as well as Hayes (1982), Archangeli (1988b), Lahiri and van der Hulst (1988), Halle *et al.* (1993) and Mester (1994).

Accent in English and/or Dutch (§4.5) is discussed by, for example Halle and Keyser (1971), Selkirk (1980), van der Hulst (1984), Langeweg (1988), Kager (1989), Zonneveld (1993), Burzio (1994) and Trommelen and Zonneveld (1999).

For an account of accent within a historical context, see Salmons (1992). See also Lahiri *et al.* (1999). Some of the papers in Archibald (1997) deal with the acquisition of accent. See also Fikkert (1994), and, for a general account of acquisition, Jusczyk (1997).

Appendix

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993, updated 1996)

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

Clicks	Voiced implosives	Ejectives
ʘ Bilabial	ɓ Bilabial	' Examples:
ǀ Dental	ɗ Dental/alveolar	pʼ Bilabial
ǃ (Post)alveolar	ʄ Palatal	tʼ Dental/alveolar
ǂ Palatoalveolar	ɠ Velar	kʼ Velar
ǁ Alveolar lateral	ʛ Uvular	sʼ Alveolar fricative

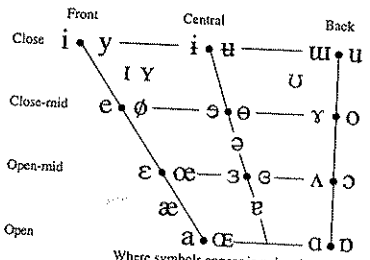
OTHER SYMBOLS

ʍ Voiceless labial-velar fricative
w Voiced labial-velar approximant
ɥ Voiced labial-palatal approximant
ʜ Voiceless epiglottal fricative
ʢ Voiced epiglottal fricative
ʡ Epiglottal plosive

ɕ ʑ Alveolo-palatal fricatives
ɺ Alveolar lateral flap
ʧ Simultaneous ʃ and x

Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary. k͡p t͡s

VOWELS



Where symbols appear in pairs, the one to the right represents a rounded vowel.

SUPRASEGMENTALS

ˈ Primary stress
ˌ Secondary stress ˌfoʊnəˈtɪʃən
ː Long eː
ˑ Half-long eˑ
˘ Extra-short ĕ
| Minor (foot) group
‖ Major (intonation) group
. Syllable break ɹi.ækt
‿ Linking (absence of a break)

TONES AND WORD ACCENTS

LEVEL		CONTOUR	
é or ˥	Extra high	ě or ˩˥	Rising
é ˦	High	ê ˥˩	Falling
ē ˧	Mid	e᷄ ˧˥	High rising
è ˨	Low	e᷅ ˩˧	Low rising
ȅ ˩	Extra low	e᷈ ˥˩˥	Rising-falling
↓	Downstep	↗	Global rise
↑	Upstep	↘	Global fall

DIACRITICS Diacritics may be placed above a symbol with a descender, e.g. ŋ̊

◌̥	Voiceless	n̥ d̥	◌̤	Breathy voiced	b̤ a̤
◌̬	Voiced	s̬ t̬	◌̰	Creaky voiced	b̰ a̰
◌ʰ	Aspirated	tʰ dʰ	◌̼	Linguolabial	t̼ d̼
◌̹	More rounded	ɔ̹	◌ʷ	Labialized	tʷ dʷ
◌̜	Less rounded	ɔ̜	◌ʲ	Palatalized	tʲ dʲ
◌̟	Advanced	u̟	◌ˠ	Velarized	tˠ dˠ
◌̠	Retracted	e̠	◌ˤ	Pharyngealized	tˤ dˤ
◌̈	Centralized	ë	◌̴	Velarized or pharyngealized	ɫ
◌̽	Mid-centralized	e̽	◌̝	Raised	e̝ (ɹ̝ = voiced alveolar fricative)
◌̩	Syllabic	n̩	◌̞	Lowered	e̞ (β̞ = voiced bilabial approximant)
◌̯	Non-syllabic	e̯	◌̘	Advanced Tongue Root	e̘
◌˞	Rhoticity	ɚ a˞	◌̙	Retracted Tongue Root	e̙

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