

Foot Inventory

The central question addressed in any parametric metrical theory concerns the basic foot shapes it allows. This chapter begins with three case studies, given as examples of the three basic foot types to be assumed here. I then argue that these three types suffice as a complete set of bounded feet—that the set is both highly restrictive and empirically sufficient. The last part of the chapter argues that the inventory is grounded in a basic law of rhythmic structure, to be called the **Iambic/Trochaic Law**.

The three-member inventory presented here was first proposed independently by McCarthy and Prince 1986 and Hayes 1987; both proposals were based on observations about foot typology made in Hayes 1985.

4.1 SOME EXAMPLES OF BOUNDED SYSTEMS

4.1.1 Syllabic Trochees in Pintupi

Pintupi is a Pama-Nyungan language of Australia, described by Hansen and Hansen 1969, 1978; for a related dialect see Douglas 1958. The metrical analysis given here follows that of Hammond 1986 in most respects. This presentation covers most of the Pintupi stress system; a further detail is presented in § 5.1.9. The simplifications assumed here do not crucially affect the status of Pintupi as an illustration of a particular foot type, namely the **syllabic trochee**.

Main stress in Pintupi falls on the initial syllable of a word. Secondary stress falls on every other syllable thereafter, but not on final syllables. Content words in Pintupi usually have at least two syllables (§ 5.1.9 discusses the exceptions), and they may have up to nine syllables in the data presented. The examples below are from Hansen and Hansen 1969, 163.

- | | | | |
|--------|-----------|--------------------------------|------------------------|
| (1) a. | σ σ | <i>páŋa</i> | 'earth' |
| b. | σ σ σ | <i>t^jútaya</i> | 'many' |
| c. | σ σ ð σ | <i>málawàna</i> | 'through from behind' |
| d. | σ σ ð σ σ | <i>púliŋkàlat^ju</i> | 'we (sat) on the hill' |

- | | | | |
|----|-------------------|--|---------------------------------------|
| e. | σ σ ð σ ð σ | <i>t^jámulìmpat^jùŋku</i> | 'our relation' |
| f. | σ σ ð σ ð σ σ | <i>tíliŋgulàmpat^ju</i> | 'the fire for our benefit flared up' |
| g. | σ σ ð σ ð σ ð σ | <i>kúran^jùlulìmpat^jùŋa</i> | 'the first one (who is) our relation' |
| h. | σ σ ð σ ð σ ð σ σ | <i>yúma.ŋŋkamàrat^jùŋaka</i> | 'because of mother-in-law' |

In support of their stress description, Hansen and Hansen note that certain vowels have distinct allophones in stressless syllables; cf. [t^járan^táran^tpa/] (phonemic /t^jaran^táran^tpa/) 'ant (species)' (1969, 157), where stressless /a/ is realized phonetically as [ʌ]. Word-final vowels that are also phrase-final may be devoiced, again supporting the view that they are stressless.

The analysis of Pintupi stress is straightforward. The calculation of stress clearly must go from left to right, since the alternating pattern is "left-justified." Since stresses occur every two syllables, and odd syllables get stressed, the foot structure is determined: feet must be disyllabic, with prominence on the initial syllable of the foot. This structure will be referred to throughout this book as the "syllabic trochee":

- (2) **Syllabic Trochee** (× .)
σ σ

Syllabic means that the foot template simply counts syllables, ignoring their internal structure; **trochee** is borrowed from classical metrics and means 'disyllabic foot with initial prominence'.

The difference between primary and secondary stress in Pintupi can be derived by constructing an additional layer of metrical structure (the **word layer**) atop the feet, using End Rule Left (§ 3.12). Thus the full analysis is as in (3).

- (3) **Foot Construction** Parse words into syllabic trochees, going from left to right.

Word Layer Construction		End Rule Left	
a.	(× .)(× .)(× .)	b.	(× .)(× .)(× .)
	σ σ σ σ σ σ		σ σ σ σ σ σ
	<i>t^jámulìmpat^jùŋku</i>		<i>tíliŋgulàmpat^ju</i>
	(× .)(× .)(× .)		(× .)(× .)(× .)
	σ σ σ σ σ σ		σ σ σ σ σ σ
	<i>t^jámulìmpat^jùŋku</i>		<i>tíliŋgulàmpat^ju</i>

Note that the final syllable in (3b) is a constituent of the word layer but belongs to no foot, since the template does not allow monosyllabic feet. Unfooted syl-

lables are in general assumed to be stressless. It can be seen that the theory adopted here explicitly rejects the view that all syllables must be footed. For further discussion, see § 5.1, § 5.2.3, and chapter 8.

Further examples of syllabic trochees are given in § 6.2.

4.1.2 Iambs in Seminole/Creek

Seminole and Creek are the names used for two dialects of a single Muskogean language. Both are spoken in Oklahoma, Seminole in Florida as well. Seminole/Creek has played an influential role in the history of metrical theory. Earlier metrical analyses include Halle and Vergnaud 1978; Hayes 1981; Prince 1983a; HV; Jackson 1987; Tyhurst 1987; and Blevins 1990. For all but Jackson and Tyhurst's analyses, the data were taken from the work of Haas (1977), who discovered the basic factual generalizations. Below, I have relied in addition on data and comments from Jack Martin and Pamela Munro (p.c.).

Seminole/Creek syllables fall into two classes: light (CV) and heavy (CVC, CV:, and longer). I will first describe the patterning of accent in bare stems, in some cases accompanied by closely cohering affixes. The relevant forms are according to Jackson 1987 those derived at Level I of the morphology; I will refer to them as **simplex words**.

The accentual pattern of simplex words is as follows. If a word consists of only light syllables, accent falls either on the penult or on the final syllable, whichever is preceded by an odd number of syllables. In the data below, /c/ represents a phoneme variously realized as [č] or [tʃ].

(4) a.	/c/	<i>cokó</i>	'house'	Tyhurst 162
		<i>ifá</i>	'dog'	T 163
b.	/c c/	<i>am-ífa</i>	'my dog'	T 163
		<i>osána</i>	'otter'	T 163
c.	/c c c/	<i>pom-osaná</i>	'our otter'	T 163
		<i>apataká</i>	'pancake'	T 163
d.	/c c c c/	<i>am-apatáka</i>	'my pancake'	T 163
		<i>anokicíta</i>	'to love'	J.M. p.c.
e.	/c c c c c/	<i>isimahicíta</i>	'one to sight at one'	Haas 203
		<i>am-anokicíta</i>	'to love mine'	J.M. p.c.
f.	/c c c c c c/	<i>itiwanayipíta</i>	'to tie each other'	H 203
		<i>amanokic-ak-íta</i>	'to love mine (pl.subj.)'	J.M. p.c.

The presence of heavy syllables affects stress: simplex words ending in /-/ receive final accent (5), whereas simplex words ending in /-c/ receive penultimate accent (6).

(5) a.	/c/	<i>fó:</i>	'bee'	T 162
b.	/c c/	<i>nihá:</i>	'lard'	T 162
c.	/c c c/	<i>hoktí:</i>	'woman'	Jackson 91

d.	/c c c/	<i>hitot-í:</i>	'snow'	T 163
e.	/c c c c/	<i>hañ:issí:</i>	'moon'	J.M. p.c.
f.	/c c c c/	<i>akhasí:</i>	'lake'	T 165
g.	/c c c c c/	<i>tími:tkí:</i>	'thunder'	T 162
(6) a.	/c c c/	<i>ícki</i>	'mother'	T 165
b.	/c c c c/	<i>kofócka</i>	'mint'	T 162
c.	/c c c c c/	<i>akcáwhka</i>	'stork'	J.M. p.c.

If the heavy syllable occurs earlier in the word, stress falls either on the penult or on the final syllable, whichever is separated by an odd number of light syllables from the preceding heavy. This resembles the pattern found in words with all light syllables (4).

(7) a.	/c c c c/	<i>ta:skitá</i>	'to jump (sg. subj.)'	J 82
	/c c c c c/	<i>atilyoyitá</i>	'to gather (pl. obj.)'	J.M. p.c.
	/c c c c c c/	<i>nañkitikaroyitá</i>	'to hit (pl. obj.)'	J 82
b.	/c c c c c/	<i>ta:shokíta</i>	'to jump (dual subj.)'	J 82
	/c c c c c c/	<i>tokoñhokíta</i>	'to run (dual subj.)'	J 82
c.	/c c c c c c c/	<i>ikkosapitá</i>	'one to implore'	H 204

The analysis given here for these facts is an adaptation of earlier foot-based accounts, cited above. The foot template allows at most two syllables and is right-strong; and any disyllabic foot must have a light syllable as its left member. I will call this foot template the **iamb**, again following the terminology of classical metrics.

(8) **Iamb** Form $\cup \sigma$ if possible; otherwise form $\cup (\times)$

This formulation of the iamb differs slightly from earlier accounts in that it does not allow a foot to consist of a single light syllable. For discussion of such feet, see § 5.1. Anticipating this later discussion, one could say that an iamb is basically /c c/ or anything shorter, with a separate provision (not specific to iambs) that excludes /c/.

Halle and Vergnaud 1978 first observed that the odd/even count respected in Seminole/Creek can be derived by means of parsing into maximally binary feet. The particular rule adopted here is given in (9):

(9) Foot Construction	Form iambs from left to right.
a. $(\cup \times)(\cup \times)$	b. $(\cup \times)(\cup \times)$
c. $(\cup \times)(\cup \times)$	
<i>apataka</i>	<i>amapataka</i>
<i>tokoñhokita</i>	<i>akcawhka</i>
d. $(\cup \times)(\cup \times)$	e. $(\cup \times)(\cup \times)$
f. $(\cup \times)(\cup \times)$	
<i>tími:tki:</i>	

The three legitimate iamb shapes, / \sim \neq /, / \sim \neq /, and / \neq /, can be seen in these forms. When a single light syllable is left over at the end of the parse, as in (9b-e), no foot is formed, since / \neq / is excluded as a foot.

Once feet are in place, the derivation of the position of accent is straightforward: we create a word layer with End Rule Right (§ 3.12):

(10) Word Layer Construction		End Rule Right
a. (x) (. x)(. x) v v apataká	b. (x) (. x)(. x) v v amapatáka	c. (x) (x)(. x) - v ta:shokíta
d. (x) (. x)(. x) v v toko:shokíta	e. (x) (x)(x) - v akcáwhka	f. (x) (x)(x)(x) - - ti:ni:tki:

In general, this procedure will derive the accent patterns outlined above. Notice the crucial mechanism in avoiding accent on the final syllables of (10b-e): the final syllable cannot support a foot, since feet of the form / \neq / are disallowed. Thus the final syllable provides no docking site for the word layer grid mark, due to the Continuous Column Constraint (§ 3.4.2):

(11) *(x) (x)(. x) - v ta:shokíta
--

If / \neq / feet are disallowed, then in principle Seminole/Creek could not have words consisting of a single light syllable, assuming (see § 3.8.5, § 5.1) that every word must be footed. This is indeed the case; content words of the form / \neq / are missing (Jack Martin, p.c.), and (as Martin points out) the phonology of the language suggests that this absence is not accidental. In particular, an optional rule of initial short vowel deletion fails to apply if it would create a / \neq / word: compare /ifa+wo:hka/ \rightarrow ifawó:hka, fawó:hka 'dog-barker' = 'hound' with /ifa/ \rightarrow ifá (only) 'dog'. CV function words do occur: *ma* 'that, there'; *ya* 'this, here'. According to Martin, such words usually do not occur as isolation forms; they either are amplified by a case marker (nom. *ma-t*, *ya-t*, acc. *ma-n*, *ya-n*) or occur unaccented in the presence of an adjacent noun, where they might be analyzed as having been phonologically cliticized. When mentioned, as in "the word *ma*," they are lengthened, but retain the typical schwa vowel quality of short /a/.

The metrical structures of (10) in principle predict the existence of secondary stresses. The extent to which these are actually realized in phonetic forms is an unsettled issue (Haas 1977; Blevins 1990; Martin p.c.). The difficulties

arise from the fact that Seminole/Creek lacks the usual phonetic correlates of metrical structure, because its accentual system is essentially tonal (Haas 1977). Typically, a High tone is placed on the metrically strongest syllable, and other tones may appear as well, as part of a verbal grade system. As Martin 1992 shows, these additional tones sometimes dock onto the strongest syllables of feet other than the rightmost one in the word. This suggests that full metrical structure is indeed present in Seminole/Creek surface representations, although its phonetic manifestation is often incomplete. For further discussion, see § 5.5.2.

The crucial aspect of Seminole/Creek for our purposes is that its foot structure forms a clear illustration of the iamb, one of the basic foot templates adopted here. Further illustrations appear in § 6.3.

4.1.3 Moraic Trochees in Cairene Arabic

The stress pattern of Arabic as spoken in Cairo has also played a central role in the development of metrical theory. The first formal metrical account of Cairene stress was McCarthy 1978, 1979a, and numerous variants have been proposed in subsequent literature, including Halle and Vergnaud 1978; Hayes 1981; Prince 1983a; Selkirk 1984; and HV. The analysis below is based on these accounts, as well as the earlier quasi-metrical analysis of Allen 1973, 165.

The facts treated include data from "Cairene Classical Arabic," which is the pronunciation of Classical Arabic employed in universities of Cairo. Data of this sort are from Mitchell 1960 and Kenstowicz 1980, 40. With a possible minor exception, such words are pronounced with the same stressing that is assigned to colloquial Cairene forms. The Classical forms are of interest since they show a wider array of possible syllabic shapes and thus provide a stiffer test for any proposed account. The claimed difference between stress in Cairene Classical Arabic and in colloquial is that words with final long vowels are said to receive nonfinal stress in Cairene Classical but final stress in the colloquial (where they are rare).

Syllables in Cairene fall into three categories: light CV (/ \neq /), heavy CVC and CV: (/=/), and superheavy CVCC and CV:C, symbolized / \neq /. Superheavy syllables are largely restricted to final position. The basic stress pattern, which was originally discovered by Mitchell 1960, is stated in (12). In the data, Cairene Classical forms are marked *Cl*. Most of the glosses are as provided by McCarthy 1979a; and page numbers for forms from Mitchell 1960 are from the 1975 reprinting of his article.

(12) a. Stress the final syllable if it is superheavy or colloquial /CV:/:		
/ \sim \neq /	katábt	'I wrote' Harrell 1957, 15
/- \neq /	haǰǰátt	'pilgrimages' <i>Cl</i> . Mitchell 1975, 77
/ \sim \neq /	gató:	'cake' Mi 81

- (15) a. **Final Superheavies, Final CV: in Colloquial Words**
- | | | | | |
|----------|-------|--|------------|----------|
| (x) | (x) | | (x) | (x)(x) |
| v | v | | v | v |
| katab(t) | gato: | | mudarr(i)s | harða:mi |
- b. **Heavy Penults**
- c. **Light Penult, Even Parity**
- | | | | | |
|---------|------------|-----------------|---------------|--------------|
| (x .) | (x .)(x .) | (x .)(x .)(x .) | (x)(x .)(x .) | (x)(x .) |
| v | v | v | v | v |
| fih(i)m | katabitu | šaġaratuhuma(z) | ʔadwiyatuhu | mudarrisi(t) |
- d. **Light Penult, Odd Parity**
- | | | | |
|--------|------------|-----------|------------------|
| (x .) | (x .)(x .) | (x)(x .) | (x)(x .)(x .) |
| v | v | v | v |
| kataba | šaġaratuhu | ʔinkasara | ʔadwiyatuhuma(z) |

It can be seen that the alternating count of light syllables is carried out by the bimoraic foot structure. The count is restarted after heavy syllables, since heavy syllables are necessarily followed by foot boundaries.

The main stress can then be located in the correct position by creating a higher metrical layer, as in (16):

- (16) **Word Layer Construction** **End Rule Right**
- | | |
|----------------|---------------------|
| a. (x) (x) | b. (x) (x) |
| (x) (x) | (x) (x) |
| v | v |
| katab(t) gató: | mudarr(i)s harðá:mi |
- c. (x .) (x .)(x .) (x .)(x .)(x .) (x)(x .)(x .) (x)(x .)
- | | | | | |
|---------|----------|-----------------|-------------|--------------|
| v | v | v | v | v |
| fih(i)m | katabitu | šaġaratuhúma(z) | ʔadwiyatúhu | mudarrisi(t) |
- d. (x .) (x .)(x .) (x)(x .) (x)(x .)(x .)
- | | | | |
|--------|------------|-----------|------------------|
| v | v | v | v |
| kataba | šaġaratuhu | ʔinkásara | ʔadwiyatúhuma(z) |

An important aspect of the analysis is that a single light syllable (including syllables counted as light due to extrametricality) cannot form a foot. This is in fact independently supported by the absence of CV(C) content words in Cairene (Broselow 1988; for the minimal word in Arabic in general see McCarthy and Prince 1990, 251–60). Because /ɔ/ feet are disallowed, in the cases of (16d) the final syllable is not footed. End Rule Right cannot promote this syllable, since to do so would violate the Continuous Column Constraint (cf. (11) for Seminole/Creek):

- (17) *(x)
- | |
|---------|
| (x .) |
| v |
| kataba |

The same facts are accounted for in McCarthy's analysis by invoking a labeling rule based on branching. My assumption is that with appropriate devices this kind of labeling rule can be dispensed with (§ 3.12).

The metrical structures that generate primary stress also predict secondary stresses on the heads of non-primary stressed feet. Kenstowicz 1980 notes that at least for certain word shapes, this prediction is independently supported, since only vowels in weak position within the foot undergo a rule of phrasal Syncope. Secondary stress is also supported by the observations of Harrell 1960 on a different speech style (§ 6.1.2). However, the analysis cannot derive the secondary stress pattern described by Welden 1980; if Welden's observations are correct, then we must posit additional rules that would go beyond the scope of the theory proposed here. Welden's observations are in any event controversial; see HV, p. 60.

Further examples of stress systems based on the moraic trochee are presented in § 6.1.

4.2 JUSTIFYING THE FOOT INVENTORY

The three analyses just presented were chosen as representative cases of the three basic bounded foot types adopted in this book. They are restated in (18):

- (18) a. **Syllabic Trochee** (x .)
- | |
|-----|
| σ σ |
|-----|
- b. **Moraic Trochee** (x .) (x)
- | | | |
|-----|----|---|
| v v | or | - |
|-----|----|---|
- c. **Iamb** (. x) (x)
- | | | |
|-----|----|---|
| v σ | or | - |
|-----|----|---|

I attempt to justify this inventory in two ways: by showing that it best fits the data, and by showing that (initial appearances to the contrary) it forms a natural and expected set. The first task is a very large one, and in this chapter I give only the form of the arguments, filling in data in the later chapters. The second task is undertaken in § 4.5.

One way of determining what feet are needed is to consider the typology of stress patterns from a different point of view. In particular, the framework of Prince 1983a provides a way of classifying the logical possibilities straightforwardly, so we can check what is empirically attested. As noted in § 3.8.3, Prince's theory assigns stress with direct placement of grid marks instead of foot parsing, using two basic parameters: