Stress and Metrical Structure

Marc van Oostendorp

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Background

- Features are organized into segments, segments are organized into syllables, and syllables are organized into feet.
- The primary evidence for foot structure comes from stress (accent)
- Foot can take different forms in different languages, according to a small set of parameters.
- Within a word, one of the feet usually stands out: it assigns main stress.

1 Metrical feet

The notion of a *foot* is derived from the study of classical metrics, the study of rhythm in verse; it has been extended to the study of the rhythmic grouping of syllables within the word. In English (as well as Dutch) poetry, poetic feet are usually bisyllabic, they consist of two syllables. One of these two is more prominent than the other, and this gives us two options:

- The first syllable is the most prominent one; we then have a **trochee**:

s	w	s	w	s	w	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)

  In this example — from Henry Wadsworth Longfellow's poem *Hiawatha*, a long poem entirely written in trochees — we see some useful notation illustrated. Accented syllables are denoted by an accent (á), unaccented ones by a breve symbol (ă). Furthermore we put an *s* (for *strong* above the accented syllable and a *w* (for *weak*) above an unaccented one. The brackets indicate that the syllables are grouped in a foot.

- The second syllable is the most prominent one; we then have an **iamb**:

w	s	w	s	w	s	w	s	w	s		
(hĭj	légt)	(hět	spán-)	(tŏuw	óm)	(dě	pó)-	(těn	ván)	(hět	béest)

Iambic and trochaic feet are the most important building blocks in the stress systems of most stress languages too. Feet are different from all other levels of phonological organization in one important way. Although it is hardly ever contested that all languages have features, segments and syllables, there is quite a number of languages for which there is no evidence for metrical feet; for these languages it cannot be said that some syllable is systematically stronger than its phonological neighbours.

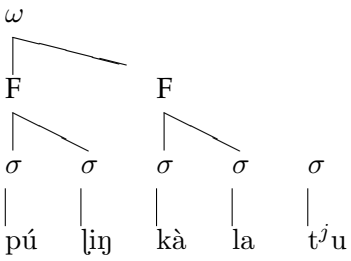
Languages which do have feet, choose to have either iambic or trochaic feet. This is a parametric choice; there might be no languages in which the two types of feet are mixed.

Pintupi, a Pama-Nyungan language of Australia is a typical example of a language with trochaic feet (Hayes, 1995):

(1)	a.	ˊσσ	páɳa	'earth'
	b.	ˊσσσ	tʲúɻaya	'many'
	c.	ˊσσ`σσ	máɭawàna	'through from behind'
	d.	ˊσσ`σσσ	púɭiŋkàlatʲu	'we (sat) on the hill'
	e.	ˊσσ`σσ`σσ	tʲámulìmpatʲùŋku	'our relation'

Here we have used an acute accent (á) to denote primary stress, and a grave accent (à) to denote secondary stress. The notation which we use in these examples is convenient because it is compact. However, many phonologists really think of these structures in terms of **trees**. The form in (**??**d), for instance, is pictured as follows:

(2)



The straight lines here represent '**head**s' — the most prominent members in a constituent — whereas slanted lines represent '**dependent**s' — less prominent members. Thus *pu* is the head of the foot *puɭiN*, and this foot is in turn the head of the whole word. For this reason, *pu* gets most stress in the word (primary stress), whereas *kà* (the head of a foot which is not the head of the word) gets less stress (secondary stress) and the other syllables get no stress at all.

In a word with an odd number of syllables, such as the present one, there will be one syllable which does not participate in the foot structure at all: it is **unfooted**. Languages can choose where they leave their unfooted syllable, but usually this will be at one of the two edges of the word: in Pintupi, this is the righthand edge of the word. In other languages, such as MalakMalak (another Australian language, spoken in Western Arnihem), it is the left edge of the word:

(3) a. *wúru* 'arm, rivulet'
b. *melpápu* 'father (emphatic)'
c. *múnankàra* 'beautiful'
d. *arkíniyàŋka* 'we are all going to stand'
e. *n´önör`önöyùnka* 'you (pl) will lie down'

We thus have two parameters along which languages may vary:

- iambic feet vs. trochaic feet
- first syllable vs. last syllable unfooted in words with an odd number of syllables

Until now, we have only seen instances of trochaic languages. Creek is a famous example in the literature of a language with trochees.

(4) a. *cokó* 'house'
b. *amífa* 'my dog'
c. *apataká* 'pancake'
d. *anokicíta* 'to love'
e. *isimahicitá* 'one to sight at one'

That we are dealing with an iambic system rather than with a trochaic one, is something we can most easily see in words with an even number of syllables; e.g. a word with two syllables simply has an iambic pattern, which is most easily explained if we assume that it consists of one iambic foot. From the odd-numbered syllable words we can furthermore learn that it is the last syllable of the word which is unfooted. For some reason, this seems to be the option which is chosen by most iambic languages; as a matter of fact, some scholars believe that all iambic languages choose to leave the final syllable unfooted rather than the initial one. One potential example is Weri, but the data for this language are rather sketchy:

(5) a. *ŋintíp* 'bee'
b. *kulipú* 'hair of arm'
c. *ulùamít* 'mist'

d. *akunètepál* 'times'

It is not clear at present why there are no well attested examples of this type of language; given the typology suggested above, we would expect four kinds of languages, but in actual practice only three seem to be attested so far.

Leaving this problem, apart for a moment, we now have to translate our 'parameters' into optimality-theoretic constraints. One way of doing this is the following:

(6) a. i. ALIGN(Foot, Left, ´σ, Left): The left edge of a foot should be aligned with the left edge of a syllable (i.e. feet are trochaic)

ii. ALIGN(Foot, Right, ´σ, Right): The right edge of a foot should be aligned with the right edge of a syllable (i.e. feet are iambic)

b. i. ALIGN(Word, Left, Foot, Left): The left edge of a word should be aligned with the left edge of a foot (i.e. no unfooted syllables at left edge)

ii. ALIGN(Word, Right, Foot, Right): The right edge of a word should be aligned with the right edge of a foot (i.e. no unfooted syllables at right edge)

These constraints are instances of some more general family of constraints, aligning phonological and morphological edges to each other. We may wonder, by the way, whether it is really necessary to assume that all instances of this general constraint scheme are really present in all languages. The two constraints in (6a) are in complete conflict; if we rank one above the other, the other will become completely invisible. It seems more economical to assume that in cases such as this, there is real parameter setting: a language may choose either 'Left' or 'Right' alignment at the level of the foot. (Something similar might apply at the level of the word.)

2 Syllable quantity

In the languages we have considered so far, all syllables were treated equally. However, in quite a substantial number of the world's languages, stress is **quantity sensitive**: the stress system looks at the structure of syllables and distinguishes between (at least) two types of them: **heavy** and **light** syllables. The distinction is usually connected to the structure of the rhyme in the following way:

(7) In heavy syllables, something follows the vowel; in light syllables, nothing does.

Variations on this theme are also possible. For instance in certain languages, syllables are heavy *iff* they are closed by a consonant of a certain type, and light otherwise.

A famous example of a language with a quantity-sensitive system is the Uto-Aztecan language Tübatulabal. In this language, the distinction between light and heavy syllables is made in the following way:

(8) In heavy syllables, vowels are long; in light syllables, vowels are short.

You may check for yourself how this distinction can be seen as a special case of (7) if we base ourselves on autosegmentalist assumptions on the skeleton.

Consider the following facts from Tübatulabal (we do not distinguish between primary and secondary stress in these examples):

(9) a. *ipónihwín* 'of his own skunk'
b. *witáŋhatál* 'the Tejon Indians'
c. *wítaŋhátalá:bacú* 'away from the Tejon Indians'
d. *yú:dú:yú:dát* 'the fruit is mashing'
e. *haníla* 'the house (obj.)'
f. *tá:háwilá:p* 'in the summer'
g. *waša:gáhajá* 'it might flame up'
h. *ánaŋí:nínimút* 'he is crying wherever he goed (distr.)'
i. *pitípití:dinát* 'he is turning it over repeatedly'

One thing which strikes us if we study these examples, is that all long vowels are stressed. This is a result of a constraint which is usually called WEIGHTTOSTRESS:

(10) WEIGHTTOSTRESS: Heavy syllables should be stressed.

This constraint has a very high ranking in Tübatulabal grammar — it is never violated. Another observation we can make is that a light syllable before a heavy syllable stays always stressless, whereas light syllables following them are sometimes stressed. This is an indication that we are dealing here with an iambic system: light syllables tend to go into feet with a head on their righthand side. A similar conclusion may be drawn from the first two words, in which there is no heavy syllable at all, and in which the stress pattern is w s w s.

In other words, we may assume that also the following constraint is operative:

(11) ALIGN(Foot, Right, ´σ, Right) (henceforth abbreviated as IAMB)

Together, these two constraints will give analyses such as the following:

(12) a. (ipó)(nihwín)
b. (witáŋ)(hatál)
c. (haní:)la
d. wi(taŋhá)(talá:)(bacú)

The last two examples are not in accordance with the facts: we predict the last syllable in (12c) and the first one in (12d) to be stressless, but this is not the case: they are stressed.

The difference between Tübatulabal and the languages we have seen so far is that in the latter all feet need to be binary: they need to have *both* a head and a dependent. For Tübatulabal, it is enough if they have a head (there are no languages in which it is enough if they only have a dependent: heads are obligatory parts of constituents). Formally, Creek and the other languages have a high-ranking constraint on binarity:

(13) FOOTBIN: A foot needs a dependent.

In Tübatulabal, this constraint is dominated by another constraint, which is violated in the other languages:

(14) a. PARSE-σ: Every syllable needs to be parsed into a foot.
b. Tübatulabal: PARSE-$\sigma \gg$FOOTBIN
c. Creek: FOOTBIN$\gg$PARSE-σ

Notice that we can see from examples such as (9d) that FOOTBIN is indeed lowly ranked in Tübatulabal: this word consists exclusively of feet which have only one syllable. The reason for this is of course that all syllables (but the last one) are heavy. In other words, this piece of data provides us with evidence that WEIGHTTOSTRESS$\gg$FOOTBIN, but also that IAMB$\gg$FOOTBIN (because otherwise we could have solved our problem by making the last two syllables of (9d) into one foot). All in all, we thus have established the following grammar for Tübatulabal:

(15) PARSE-σ,WEIGHTTOSTRESS,IAMB$\gg$FOOTBIN

3 Faithfulness to feet

Word stress in Dutch — as well as in English and German, which have very similar systems — is quite puzzling at first. We may observe that stress can be on many different syllables of the word:

(16) a. *last syllable*: *chocolá* 'chocolate'
b. *penultimate syllable*: *pyjáma* 'pyjamas'
c. *last syllable*: *Pánama* 'Panama'

How are we going to account for this lexical variation? An obvious answer to this is: apparently Dutch has a strong faithfulness requirement on underlying foot structure:

(17) FAITHFOOT: Do not delete underlying feet.

There are reasons to assume that Dutch feet are trochees, and furthermore that *pyjama* (penultimate stress) represents the default. These reasons are manifold; one of them is language acquisition, in which children tend to regularize the other patterns to this one. This gives us the following ranking:

(18) TROCHEE≫FAITHFOOT≫ALIGN(Word, Right, Foot, Right), FOOTBIN

We get the following tableaux for our three example words (leaving out candidates without trochees):

(19) a.

choco(lá)	FAITHFOOT	ALIGN	FOOTBIN
(chóco)la	*!	*	
cho(cóla)	*!		
☞*choco(lá)*			*

b.

pyjáma	FAITHFOOT	ALIGN	FOOTBIN
(pýja)ma		*!	
☞*py(jáma)*			
pyja(lá)			*!

c.

(pána)ma	FAITHFOOT	ALIGN	FOOTBIN
☞*(pána)ma*		*	
pa(náma)	*!		
pana(má)	*!		*

Note that it is not necessary to posit an underlying foot for the default stress structure *pyjáma*. This is what it means to be default: the grammar will assign the appropriate structure without instructions from the underlying form. (But note that it would do no harm to assign underlying structure either.)

The constraint TROCHEE is ranked most highly since there is no evidence that there is ever an iambic structure in Dutch. Even words such as *chocolá* or *patát* 'french fries' are analysed as *(chòco)(lá)* and *pa(tát)* respectively.

As a matter of fact, there must be many more metrical wellformedness constraints outranking foot faithfulness, since not everything is possible. For instance, if a word ends in a so-called **superheavy** syllable (a syllable with a long vowel and a consonant in the rhyme, or a short vowel and two consonants), this syllable is invariably stressed:

(20) *vulkáan* 'vulcano' (**vúlkaan*)

Apparently, some version of WEIGHTTOSTRESS is at work here, which would force underlying trochaic feet built on the two syllables of a hypothetical underlying **vúlkaan* to be restructured into a more well-behaved structure.

(21) TROCHEE,WEIGHTTOSTRESS≫FAITHFOOT≫ALIGN(Word, Right, Foot, Right)

Another observation to be made is that Dutch — like many other languages — displays the effects of a so-called *three-syllable window*: stress is on one of the last three syllables of the word, but never outside it. In other words, (monomorphemic) forms of the following type are unattested in Dutch:

(22) **mácaroni*

The reason for this is straightforward. If we posit an underlying structure *(máca)roni*, the last two syllables are still unfooted. We can then parse these two into a new foot, which will receive primary stress, because this is always on the last foot of the word in Dutch. This makes *(máca)roni* different from *(pána)mi*, where there is no room to build an extra binary foot.

Bibliography

Hayes, Bruce (1995). *Metrical stress theory. Principles and Case Studies*. University of Chicago Press.

Exercise 7

Give OT tableaus for the derivation of stress in three of the examples in (9) (you may choose your own words, except that you may not choose both of the first two, since these have the same pattern).