
Weeks 08-09 – Stress Patterns and Theory

October 28, 2008

1 Overview

- (1) So far:
 - a. What is the right way to describe the phonological competence of a speaker?
descriptively adequate theory
 - b. How can such competence be obtained from the kinds of evidence available to children?
explanatory adequate theory
- (2) Goals of descriptively adequate theory with an eye toward explanatory adequacy
 - a. restrictiveness
 - (i) postulation of universals helps reign possible patterns
 - b. highly-valued grammars vs. less highly valued grammars might benefit learners
- (3) Today we look at the ways in which languages in the world place stress in some domain.
- (4) Questions to keep in mind:
 - a. Given the stress pattern in some particular language, what kinds of representations, rules, constraints, etc. best describe the competence of the speaker?
 - b. What are the logically possible stress patterns?
 - c. What are the actual attested patterns?
 - d. Given that the variation that exists is limited, how should this affect our theory of competence?
 - e. Can we develop a theory that predicts the attested variation and nothing (or little else)?

2 What is stress?

- (5) Answer: (Liberman and Prince 1977)
 - a. Relative prominence of portions of an utterance.
 - b. Rhythmic structure that serves as an organizing framework for an utterance.
- (6) Metrical theories of stress describe stress as essentially the same as other rhythmic phenomena (verse, music).

- a. “[the description of stress] is reminiscent of the traditional picture of verse scansion, so that the theory as a whole deserves the name ‘metrical’” (Lieberman and Prince 1977)
- (7) Function of rhythm in language (Trubetzkoy 1939, also Kager 1996)
- a. Delimitative: Changes in rhythm mark the boundaries of domains.
 - b. Culminative: Beats of certain strength mark the presence of words or lexical morphemes.
 - c. Culminativity: Every (content) word must have at least one stressed syllable.
 - (i) More generally: Every domain must have a peak of prominence.
 - d. Distinctive: Differences of rhythm distinguish words or lexical categories (ex. *pérmít* vs. *perμίt*, *récord* vs. *recórd*, and many other such pairs in English).
- (8) Stress is distinct from the phonetic and phonological properties that are correlated with it:
- a. Phonetic properties correlated with stress (with cross-linguistic differences): amplitude, length, high/low pitch or pitch changes
 - (i) But: “The definition of stress is one of the perennially debated and unsolved problems of phonetics” (Hayes 1995: 5) .
 - b. Phonological properties that ‘express’ or are sensitive to stress:
 - High tone on stressed syllable in Creek; High tone before stressed syll. in Greek.
 - Low tone on stressed syllable in Chamorro, Malayalam.
 - Stressed syllables have the ability to carry more tone distinctions in Chinese dialects.
 - Stressed syllables have the ability to carry more vowel distinctions, and vowels in stressed syllables are more resistant to coarticulation, in English.

2.1 Stress as a feature?

- (9) Other features don’t shift from segment to segment based on distance from a word edge (well, not usually...):

órin	oríginal	orìgnáality
phòtografh	photógrapher	phòtografhic

- (10) Other features don’t act at long distances (well, not usually...):

Mississíppi vs. Míssissìppi législàtors

- (11) Languages don’t require every content word to have at least one + value of other features (except maybe [syllabic]).
- (12) For just about every other feature, there is some language where it assimilates—but I know of no rules of stress assimilation.

- (17) Weri. Main stress is on the final syllable; secondary stresses fall on preceding odd-numbered syllables counting from the word end.

ulòamít ‘mist’ àkvnàtepál ‘times’

- (18) Warao. Main stress is on the penultimate syllable (penultimate = immediately before the last syllable); secondary stresses fall on all even-numbered syllables counting back from the main stress.

yà.pu.rù.ki.tà.ne.há.se ‘verily to climb’
e.nà.ho.rò.a.hà.ku.tá.i ‘one who caused him to eat’

- (19) Araucanian. Main stress is on the second syllable; secondary stresses fall on following even-numbered syllables.

e.lá.a.à.new ‘he will give me’
ki.mú.fa.lù.wu.lày ‘he pretended not to know’

3 Grid theory

3.1 Basics

- (20) (Lieberman and Prince 1977, Prince 1983)
- (21) Linguistic stress is represented by a hierarchy of grid lines, with higher columns representing greater prominence.

							lines can also be labelled with prosodic units:
line 3:				x			Prosodic Word
line 2:	x			x			Foot?
line 1:	x		x		x		Foot
line 0:	x	x	x	x	x	x	σ
	a	pa	la	chi	co	la	

- (22) The strong tendency toward rhythmic alternation is accounted for by mapping to the **perfect grid**:

$$\dots x \overset{x}{x} \overset{x}{x} \overset{x}{x} \overset{x}{x} \overset{x}{x} \overset{x}{x} \dots$$

- (23) Mapping to the perfect grid has *two binary parameters*:
- Directionality parameter: Right-to-left, Left-to-right.
 - Starting parameter: Begin with peak, Begin with trough.
- (24) **End Rules** strengthen rightmost/leftmost stresses by adding one grid mark above them.
- ER(I,Wd): place a grid mark above the leftmost (initial) grid mark on the Ft level.

- ER(F,Wd): place a grid mark above the rightmost (final) grid mark on the Ft level.
 - a. Formal statement of the End Rule (Prince 1983:27):

“Let p be the strongest grid position in a constituent C. There is a level (n + 1) such that (i) p is the only position in C with representation at level (n+1), and (ii) other positions in C have representation at level n. The End Rule says: The entry for p at level n is the rightmost/leftmost entry at level n for C.”
- (25) Operation of the End Rules is (implicitly or explicitly) subject to a well-formedness condition called the **Continuous Column Constraint** (formulation after Hayes 1995):
- a. “A grid containing a column with a mark on line n + 1 and no mark on line n is ill-formed. Phonological rules are blocked when they would create such a configuration.”
 - b. Basically, for every grid mark (except on the bottom layer) there must be a grid mark in the same column on the layer below.

3.2 Typological Predictions

★ Describe the patterns of (6) within the grid theory

	Directionality parameter	Starting parameter	End Rule
Hungarian			
Weri			
Warao			
Araucanian			

- (26) Many unattested stress system cannot be described within the grid theory, and are therefore correctly predicted not to occur.

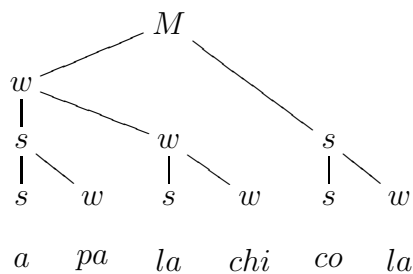
<p>‘Stresses pile up on the left’</p> <pre> x x x x x x x x x x x </pre>	<p>‘Stresses pile up on the right’</p> <pre> x x x x x x x x x x x </pre> <p>(cf. tones)</p>	<p>‘Main stress in the middle, with alternation outwards in both directions’</p> <pre> x x x x x x x x x x x x x x x x x </pre> <p>cute, but unattested</p>
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4 Alternatives to (elaborations of) the grid

(27) Grid (Lieberman and Prince 1977, Prince 1983).

				x	
	x			x	
	x	x		x	
x	x	x	x	x	x
a	pa	la	chi	co	la

(28) Stress represented by a hierarchical tree of strong and weak nodes (Lieberman and Prince 1977).



(29) Bracketed grid (contemporary theory): grids grouped into feet and words (Hayes 1995).

				x		
	(x			x)	
	(x	x)	(x)	
	(x	x)	(x	x)	(x	x)
a	pa	la	chi	co	la	

(30) Details of bracketing

- a. On line 1 (i.e., just above the syllable line), bracketings represent prosodic constituents called **feet**. We will focus on bracketings on this line (as does the literature).

(31) Some more notation

- a. Hayes (1995) alters the notation for brevity as follows.
- b. Line 0 is removed and the brackets are 'pushed up' a level.
- c. Each bracketing now contains only one 'x' mark. 'x' stands for a syllable that receives some degree of stress
'.' stands for a syllable that receives no stress.

$$\begin{array}{ccccccc} & & & & & & x \\ & & & & & &) \\ (x & & & & & &) \\ (x & . &) & (x & . &) & (x & . &) \\ a & pa & la & chi & co & la \end{array}$$

(32) We'll motivate the use of *feet* a little later.

5 Principles and Parameters

(33) Principles (Universals)

- a. The Perfect Grid
- b. The Continuous Column Constraint

(34) Parameters (Ways languages can differ)

- a. We identified three parameters proposed to account for the kinds of stress patterns attested in the world's languages.
 - (i) Directionality
 - (ii) Start with Peak/Trough
 - (iii) End Rule Left/Right

5.1 Quantity-Sensitive Patterns

(35) Example: In Latin (C)V syllables are light, all other syllables are heavy. Then we can state the stress rule as:

- a. In words at least three syllables in length, stress the penult if it is heavy, otherwise stress the antepenult. In shorter words, stress the initial syllable (Jacobs 1989, Mester 1992, Hayes 1995).

a.	a.mí:kus	L H H	‘friend, kind’
b.	gu.ber.ná:bunt	L H H H	‘they will reign’
c.	i.ni.mi:kì.ti.a	L L H L L	‘hostility’
d.	do.més.ti.kus	L H L H	‘belonging to the house’
e.	mán.da:	H H	‘entrust (2sg.imp)’
f.	ká.nis	L H	‘dog’
g.	hé.ri	L L	‘yesterday’

- b. Also note that the examples (e-f) show that stress falls initially in disyllabic words.

(36) How can we reconcile the Latin pattern with the perfect grid?

- a. Formalize syllable weight with *moras*
- b. Add a parameter *Extrametricality*.

(37) Moras

- a. Light syllables (=1 mora, monomoraic) are represented by [x], heavy syllables (> 1 mora) are represented by [x x].
 - b. We can think of vowels (and coda consonants) as projecting the moras.
 - c. Languages may differ in which syllables are counted as heavy as which are counted as light.
- (38) Extrametricality
- a. A language may allow a grid mark at the left or right edge of the word to be *extrametrical*; i.e. outside the purview of the grid. This is denoted as]x̣[.

★ With these ideas,

1. Which syllables project 1 or 2 moras in Latin?
2. Which edge (if any) may the mora be extrametrical in Latin?
3. What would the grid look like for *doméstikus*?

5.2 More on Extrametricality

- (39) In order to analyze some languages' stress systems, it is necessary to suppose that certain material at the beginnings or ends (usually ends) of words is 'left out' of the grid-mark assignment (extrametrical).
- (40) Example: Winnebago/Hocak (data originally from Miner 1979, Hale & White Eagle 1980). Siouan language from Wisconsin, with a settlement in Nebraska; about 885 speakers total.

ha.ki.rú.jik.šǎ.nã	'he pulls it taut'
hi.ra.wá.haz.rà	'the license'
ho.ki.wá.ro.kà	'swing'
ho.čǐ.čǐ.nĩk	'boy'
hi.jo.wí.re	'fall in'
hi.pi.rák	'belt'
hiš.ja.sú	'eye'

★ What are the parameter settings for Winnebago, and what has to be extrametrical?

★ How are these forms different? Any ideas about why? (Most languages require every content word to have a stress. When a word is otherwise unstressable, a special rule steps in.)

wa.jé ‘dress’
 wi.júk ‘cat’

★ Let’s try to formulate Winnebago’s rule for otherwise unstressable words.

★ Instead of extrametricality what if...

1. We allow an additional value to the Starting parameter: DoubleTrough.
2. What is the status of the Perfect Grid (since double troughs don’t occur in perfect grids)?

(41) Hayes (1981) proposes that only constituents (segments, syllables, feet [which we’ll get to later], phonological words, or affixes) may be made extrametrical.

6 Case Studies

6.1 Cairene Arabic

(42) Data taken from Hayes 1995 and elsewhere. (the variety of Egyptian Arabic spoken in Cairo—I believe these data represent a Classical style)

(43) Building the grid on moras rather than syllables, figure out the parameter settings for Cairene and what has to be extrametrical. You can assume that secondary stressed gets assigned and then wiped out by a later rule.¹

★ First make a guess based on (a-f).

a)	ká.ta.ba	‘he wrote’
b)	ka.ta.bí.tu	‘she wrote it’
c)	ša.ja.rá.tu.hu	‘his tree’
d)	fí.him	‘he understood’
e)	ša.ja.rá.tun	‘tree’
f)	ša.ja.ra.tu.hú.maa	‘their (dual) tree’

¹Alternatively, you can think of this as another parameter: Keep Secondary or Not. Here, Not.

★ Modify this guess to take care of (g-i), if necessary.

- g) ʔad.wi.ya.tú.hu ‘his drugs’
- h) ʔin.ká.sa.ra ‘it got broken’
- i) qat.tá.la ‘he killed’

★ Any ideas about how to deal with (j-l)?

- j) ka.táb.ta ‘you (m.sg.) wrote’
- k) mu.dár.ris ‘teacher’
- l) haa.ǎáa.ni ‘these (m. dual)’

(44) There is actually more to it—this is just a fragment.

6.2 Italian

★ Treat the following words as representing the basic primary—stress pattern of Italian. What are the parameter settings?

- a) mé.se ‘month’
- b) ká.sa ‘house’
- c) fǎá.to ‘breath’
- d) té.r.ra ‘earth’
- e) dʒór.no ‘day’
- f) di.ví.sa ‘uniform’
- g) tri.bú.na ‘rostrum’
- h) kom.prá.re ‘buy’
- i) kor.ní.tʃe ‘corniche’
- j) me.ta.fo.ní.a ‘metaphony’

★ Here are some words with a different stress pattern. There is no other systematic difference between these words and the basic words in (a), so something has to be different about their underlying representations. Ideas for what it could be?

- k) ká.li.tʃe ‘chalice’
- l) mú.si.ka ‘music’

★ What extra stipulation do we need to make to take care of these words?

- m) ál.be.ro ‘poplar’
- n) fí.s.si.le ‘fissionable’

★ Some word shapes, however, never show antepenultimate stress. This should follow from the analysis so far:

- o) spa.gét.ti ‘spaghetti’
- p) a.rán.tfo ‘orange (color)’
- q) am.búr.go ‘hamburger’
- r) in.tén.to ‘intent’
- s) *á.bur.go
- t) *ín.men.to

★ In addition, there are no words with preantepenultimate stress: *[dó.bi.ta.pi]. Does that follow from the analysis so far?

★ There are some words with final stress. What could we say about their underlying representations? (Note: final vowels in Italian are never long on the surface: *[par.ló:], *[pár.lo:]. Certain other vowels are long, but they aren’t marked here.)

- u) ko.li.brí ‘hummingbird’
- v) dʒo.ve.dí ‘Thursday’
- w) u.ni.ver.si.tá ‘university’
- x) li.ber.tá ‘liberty’
- y) dʒo.ven.tú ‘youth’
- z) ko.sí ‘thus’
- aa) tʃit.tá ‘city’
- bb) per.ké ‘why’

- ★ There is a famous exception to the stress pattern laid out above, [mán.dor.la] ‘almond’ (and a small number of other words like it: [pó.lit.t̄sa] ‘policy’, [á.ris.ta] ‘pork loin’). We would like to account for these few words without opening the door to completely free stress placement. Please speculate on how these words’ underlying representation might look.

7 Feet

- (45) Basic properties of feet
- Feet are groups of syllables.
 - In many theories, feet are maximally bisyllabic (but some also allow ‘unbounded’ feet).
 - Some theories require feet to be minimally bimoraic (mono-moraic feet are ‘degenerate’).
- (46) Basic foot types (assuming bisyllabic maximum)
- Trochaic: if there are two syllables, the stressed syllable is on the left: (s w) or (x .)
 - Iambic: if there are two syllables, the stressed syllable is on the right: (w s) (. x)
 - Hayes (1995) elaborates these basic foot types (next time)

7.1 Bedouin Hijazi Arabic

- (47) Example: Bedouin Hijazi Arabic (dialect of Hijazi Arabic, an Afro-Asiatic language with 6,000,000 speakers in Saudi Arabia—data originally from Al-Mozainy, Bley-Vroman & McCarthy 1985)
- (48) Form of the argument for feet: The movement of stress when stressed syllables are deleted is predictable if we have feet. Stress stays in the foot.
- (49) Last syllable is extrametrical unless superheavy (CVVC) or unless word has just two syllables, with two-mora trochees built from right to left (only the last one gets stress):

mak.túu.<fah>	‘tied (fem.sg.)’
mak.túub	‘written’
máa.la.<na>	‘our property’
(ín.ki.<sar>	‘he got broken’

- ★ Stress interacts with deletion. What happens if we order stress before deletion? After?

	sá.ħa (<i>maybe</i>)	‘he pulled’
	sa.ħáb.<na>	‘we pulled’
/saħab+at/	šhá.<bat>	‘she pulled’
/ʔinkasarat/	ʔink.sá.<rat>	‘she got broken’
	compare to	
	ʔín.ki.<sar>	

- ★ Another way of thinking about it: how does an x “know” where to go after its syllable is deleted?

$$\begin{array}{cccc} & & x & \\ x & x & x & x \\ \text{ʔin} & \text{ka} & \text{sa} & \text{<rat>} \end{array}$$

- (50) Bedouin Hijazi Arabic redux
- [a] deletes in an open syllable before [Ca]_σ (e.g. saħábat → šhábat).
 - Stress assignment involves final-rime (≈ final-syllable) extrametricality. e.g. (ʔínki)<sar>—final σ extrametrical; trochee formed by RL parse.
 - Low vowel deletion interacts opaquely with stress assignment. e.g. /ʔinkasarat/ → (ʔin)(kása)<rat> → (ʔin)(ksá)<rat>
 - Stress stays in the foot.

7.2 Winnebago (again)

- (51) This is another example that has been argued for feet.
- (Based on discussion in Kenstowicz 1994)
- (52) Recap: If we restrict ourselves to light syllables (those with short vowels), we could say that initial syllables are extrametrical and iambs are formed from left to right.

$$\begin{array}{ccc} C & C & C \\ & [+son] & \\ \text{Dorsey's Law: } 1 & 2 & 3 \rightarrow 1\ 3\ 2\ 3 \end{array}$$

/ho+š+waža/ hošawažá ‘be sick’
 /hi+kro+ho/ hikorohó ‘prepare, dress (3 sg.)’

- ★ Based on the data above, which should apply first, basic stress or Dorsey’s Law?

- (53) I know this might seem weird, but: let's assume that if the final syllable is left unfooted by the basic stress rule, it can form a “degenerate” foot. But, final stress is deleted by a late rule if it clashes with a penultimate stress.

★ In that case, is this word consistent with what we've seen so far?

/ha+ra+ki+š+rújik+šná/ harakíšurujìkšānà ‘pull taut (2d)’

★ Here come the interesting cases:

/ha+ki+rújik+šná/	hakirújìkšānà	‘pulls taut (3d)’
/hi+ra+kro+ho/	hirakórohò	‘prepare’
/māā+š+rač/	māāšárač	‘you promise’
/hi+ra+kro+ho+nira/	hirakórohònirà	‘prepare, dress (2 d.)’
/wakripras/	wakiripáras	‘flat bug’

- (54) We saw last time that there are multiple ways to ensure that disyllabic words get some stress. Do the following forms help narrow it down?

/ho+kwe/	hokewé	‘enter’
/š+wážok/	šawažók	‘mash’

- (55) (There is more to this story, and Hayes' analysis is quite different.)

7.3 Other arguments for feet

- (56) Argument for feet: Minimality
- (57) McCarthy & Prince. 1986. (see them for references): It is common for languages to impose a minimum size on content words.
- (58) Estonian: at least two moras—word-final C doesn't count.

/tānava/	tānav	‘street (nom.sg.)’
/konna/	kon:n	‘pig (nom. sg.)’
/kana/	kana (*kan)	‘chicken (nom.sg.)’

- (59) Kahnawake Mohawk: at least two syllables

/k+tats+s/	íktats	‘I offer’
/hs+yaʔks+s/	íhsyaʔks	‘you are cutting’

(60) Tagalog (not from McCarthy & Prince): at least two syllables

narses	‘nurse’ (though also nars)
bozes	‘voice’ (¿Sp. [bozes]‘voices’)
lamsyed	‘lamp’ (not current)
bolpen	‘pen’

★ How can we describe all these minimums?

(61) Hayes 1995: Can we also say that “every word must be able to undergo the stress rule”? If so, must that rule refer to feet?

(62) Consider Pitta-Pitta, whose words also must be at least two syllables:[1]

káku	‘older sister’
kákila	‘coolamon, car, buggy’
kálakùra	‘type of corroboree’

★ What would be the main stress rule for Pitta-Pitta?

★ Does your rule exclude subminimal words (*ka)? What about other formulations of the rule?

(63) Other arguments for feet

- a. Latin enclitic stress (see Kager)
- b. How stress is assigned in morphologically complex words (e.g., Poser 1986, Ste-riade 1988).
- c. Phenomena in prosodic phonology (reduplication, truncation)—see next semester, maybe.
- d. Various consonantal rules that apply to the “strong” or “weak” syllable of a foot, even if the foot is not supposed to have any stress (i.e., in languages with no secondary stress). See González 2003.
- e. Expletive infixation (see McCarthy 1982 LI article)

(64) But also see, e.g., the foot-free analysis of QI stress patterns, Gordon, Matthew (2002). A factorial typology of quantity insensitive stress. *Natural Language and Linguistic Theory* 20, 491-552.

7.4 Review

- (65) Feet are groupings of syllables (typically binary groupings)
- a. Every foot must be stressed (cf. Culminativity)
 - b. Feet are
 - (i) almost always binary:
 - trochaic, i.e. strong-initial (x .), or
 - iambic, i.e. strong-final (. x)
 - (ii) we leave it up to particular languages whether they allow ‘degenerate’ feet in certain cases: (x)

7.5 Do we need feet?

- (66) Bottom line: do we need feet?
- a. In some languages, feet appear necessary to account for the phonology.
 - b. But other descriptions are available for many other languages without feet. Does the linguistic competence of those speakers necessarily make reference to feet?
 - c. Most researchers assume feet are given, so to talk with people we have to know about them.
 - d. Big question: Is there any language where a foot-based analysis is problematic?
 - e. Big question: Can a learning mechanism ‘discover’ feet when it needs to but develop non-foot based analyses when it doesn’t need to?

8 Metrical Stress Theory (Hayes 1995)

- (67) Abandons the Perfect Grid, in favor of a limited inventory of Foot Types.
- (68) Keeps the Principles and Parameters approach.
- a. E.g. Parameter FootType (Iambic/Trochaic)
 - b. End Rules
 - c. Directonality (Left-to-Right or Right-to-Left)
- (69) So we can make statements about stress assignment like “Build trochees from left-to-right with the end rule Left”.
- (70) Notation
- a. Let L = a light syllable (1 mora, like CV)
 - b. Let H = a heavy syllable (2 moras, like CVV or CVC)
- (71) Hayes (1995) argues that the inventory of feet is asymmetric.
- a. Syllabic Trochee ($\acute{\sigma} \sigma$)
 - (i) This gives ($\acute{L} L$), ($\acute{L} H$), ($\acute{H} L$), and ($\acute{H} H$)
 - b. Moraic Trochee ($\acute{\mu} \mu$)
 - (i) This gives ($\acute{L} L$), and (\acute{H})

c. Iambic

(i) This gives (L \acute{L}), (L \acute{H}) and (\acute{H})

(72) “My specific proposal is this: the syllabic trochee is the basic mechanism available for quantity-insensitive alternation, whereas its mirror image is excluded from the inventory of basic foot types [i.e. no ‘syllabic iamb’]. This generates peak-first left-to-right and trough- first right-to-left patterns, and not their mirror images” (Hayes 1995:73).

(73) Predictions in a nutshell:

	trochees	iambis
quantity-insensitive	attested: syllabic	unattested
quantity-sensitive	attested: moraic	attested: uneven

(74) More detailed predictions of the restricted foot inventory and comparison with Hayes’ typology (Hayes 1995:73-74)

Direction	Basic Parameters		Hayes Theory Generates?	In attested typology?
	At word edge	After heavy		
LR	peak	peak	yes, moraic trochees	yes
LR	peak	trough	no	no
LR	trough	peak	marginally; moraic trochees + initial extrametricality	yes
LR	double trough	peak	no	no
LR	double trough	trough	marginally; iambs + initial extrametricality	marginally
RL	peak	peak	no	no
RL	peak	trough	yes; iambs	maybe
RL	trough	peak	no	no
RL	trough	trough	yes; moraic trochees	yes
RL	double trough	peak	no	no
RL	double trough	trough	yes; moraic trochees + initial extrametricality	yes

8.1 Quantity-insensitive (“syllabic”) trochees

(75) Any two syllables can form a trochee—moras—weight doesn’t matter.

a. ($\acute{L}L$), ($\acute{L}H$), ($\acute{H}L$), ($\acute{H}H$) vs. $*(\acute{L})$, $*(\acute{H})$, except maybe for leftover syllables

(76) Pintupi (data originally from Hansen & Hansen 1969) Australian language from Australia with 800 or more speakers.

a.	($\acute{\sigma}\sigma$)	páŋa	‘earth’
b.	($\acute{\sigma}\sigma$) σ	t ^j úɬaya	‘many’
c.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$)	máɭawàna	‘through from behind’
d.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$) σ	púɭiŋkàlat ^j u	‘we (sat) on the hill’
e.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$)	t ^j ámulìmpat ^j ùŋku	‘our relation’
f.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$) σ	tíɭiriŋulàmpat ^j u	‘the fire for our benefit flared up’
g.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$)	kúran ^j ùlulìmpat ^j ùɬa	‘the first one who is our relation’
h.	($\acute{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$)($\grave{\sigma}\sigma$) σ	yúma.ɬìŋkamàrat ^j ùɬaka	‘because of mother-in-law’

- (77) What if coda consonants aren’t moraic in this language, so that all the syllables are light? A more convincing example comes from a language with contrastive vowel length.
- (78) Votic, aka Vod (Uralic language from Russia that had 25 speakers in 1979; Ariste 1968²) IPA stress marks used below; otherwise, Ariste’s transcription. Macron ($\bar{\text{ı}}$) indicates vowel length.

($\acute{\text{L}}$ L)	'ka.na	‘hen’
($\acute{\text{L}}$ L)	'tüt.tö	‘girl’
($\acute{\text{H}}$ H)	'sā.mā	‘to get, obtain’
($\acute{\text{L}}$ L)	'ā.pa	‘aspen tree’
($\acute{\text{L}}$ H)	'ko.tō	‘home (ill.)’
($\acute{\text{L}}$ L)($\acute{\text{L}}$)	'pa.πa.,va	‘hot’
($\acute{\text{L}}$ H)($\acute{\text{L}}$)	'li.säu.gō	‘let it increase’
($\acute{\text{L}}$ L)($\acute{\text{L}}$)	'vē.ret.,tēB	‘it rolls’
($\acute{\text{L}}$ L)($\acute{\text{L}}$ L)	'so.pi.,zim.ma	‘we got along’
($\acute{\text{L}}$ L)($\acute{\text{L}}$ H)	'bö.ri.ze.,mä	‘to roar, rumble’

8.2 Quantity-sensitive (“moraic”) trochees

- (79) A foot is composed of two moras, whether they come from one syllable or two.
- a. But, typically, a foot can’t begin or end in the middle of a syllable.
- (80) ($\acute{\text{L}}\text{L}$), ($\acute{\text{H}}$) vs. $\ast(\acute{\text{L}}\text{H})$, $\ast(\acute{\text{H}}\text{H})$, $\ast(\acute{\text{H}}\text{L})$, $\ast(\acute{\text{L}})$
- a. again, ($\acute{\text{L}}$) might be OK for a leftover syllable
- (81) We saw these in Cairene. Here’s another example (if we have time).
- (82) Cahuilla (Uto-Aztecan language from Southern California with about a dozen speakers; data taken from Hayes, but originally from Seiler³) In this language, a syllable with a long vowel, diphthong, or coda [ʔ] counts as heavy.

²Ariste, Paul (1968). A grammar of the Votic language. Bloomington: Indiana University and The Hague: Mouton.

³Data sanitized a bit: optional destressing suppressed even in forms where only one transcription is given. See Hayes for discussion of final degenerate feet—they are probably destressed by a late rule.

- ★ Draw in the foot boundaries for the simple cases—what’s the parameter setting for leftover syllables (foot them or don’t foot them)?

tá.ka.li.čem	‘one-eyed ones’
táx.mu.ʔàt	‘song’
háʔ.tis.qal	‘he is sneezing’
mú:t	‘owl’
páʔ.li	‘the water (objective case)’
qá:n.ki.čem	‘palo verde (pl.)’
táx.mu.ʔàʔ.tì	‘the song (objective case)’

- ★ What happens when a heavy syllable is awkwardly placed?

sú.kàʔ.tì	‘the deer (objective case)’
pú.kàw.tè.mih	‘gopher snakes (obj. pl.)’
kíh.mà.y.ʃù.qal	‘wonder why’
pá.làw.wè.net	‘that which is beautiful, pretty’
hé.ʔi ká.kàw.là:qà	‘his legs are bow-shaped’

8.3 Quantity-sensitive (“uneven”) iambs

- (83) Here, a heavy syllable can form a foot only on its own or with a preceding L. That is, H can’t be the weak member of a foot.
- (84) (́́L), (́́H), (́́) vs. *(́́L), *(́́H), *(́́)
 a. again, (́́) might be OK for a leftover syllable
- (85) Muskogee (a.k.a. Seminole/Creek)—data originally from Haas (1977), Tynhurst (1987), and Martin. Muskogean language from Alabama and Florida, with a community of speakers in Oklahoma; about 6,000 speakers.

- ★ Use iambic feet to explain why stress is sometimes final, sometimes penultimate:

co.kó	‘house’
ni.háa	‘lard’
hok.tíi	‘woman’
íc.ki	‘mother’
o.sá.na	‘otter’
ko.fóc.ka	‘mint’
ak.cáwh.ka	‘stork’
hi.to.tíi	‘snow’
ak.ha.síi	‘lake’
ha.liis.síi	‘moon’
tii.níit.kíi	‘thunder’
taas.ki.tá	‘to jump (sg. subj.)’
a.pa.ta.ká	‘pancake’
taas.ho.kí.ta	‘to jump (dual subj.)’
a.no.ki.cí.ta	‘to love’
to.koł.ho.kí.ta	‘to run (dual subj.)’
a.ti.loo.yi.tá	‘to gather’
ij.ko.sa.pi.tá	‘one to implore’
i.si.ma.hi.ci.tá	‘one to sight at one’
naf.ki.ti.kaa.yi.tá	‘to hit (pl. obj.)’

8.4 Why the asymmetric inventory

- (86) Recall that Hayes (1995) argues, through an extensive typological survey, that these 3 are the only foot types. There are no languages with syllabic iambs, or “uneven trochees”—i.e., (H́), (H́L), (ĹL) but not *(H́H), *(ĹH).
- (87) (No moraic iambs either, but these are harder to argue about, because they would be different from uneven iambs only in allowing (LH́), which is hard to distinguish empirically from L(H́).)
- (88) Why would the asymmetry?
- (89) Moras correspond roughly to duration: H syllables last longer than L syllables.
- (90) Hayes cites psychological research on how people group rhythmic sequences of sounds. ■
- (91) Hayes cites also:
- a. similar evidence from musicians’ judgments (Cooper & Meyer)
 - b. a study of Swedish poetry (Fant, Kruckenberg & Nord) in which...
 - (i) reciters produced greater durational contrasts in iambic verse than in trochaic

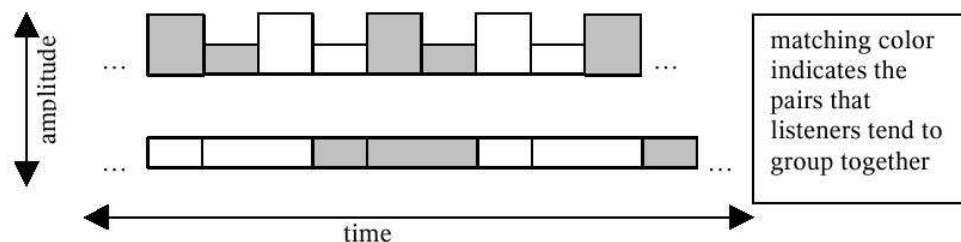


Figure 1: Grouping preference is stronger for duration-varying stimuli than for amplitude-varying stimuli.

- (ii) musicians transcribing verse into musical notation were more likely to transcribe different durations for accented and unaccented syllables in iambic verse than in trochaic
- (iii) poets use greater contrast in number of phonemes (for accented vs. unaccented syllables) in iambic verse than in trochaic (see also Newton 1975 for English verse)

9 Iambic/Trochaic Law

- (92) This law says:
- a. Elements contrasting in intensity naturally form groupings with initial prominence.
 - b. Elements contrasting in duration naturally form groupings with final prominence. (p. 80)
- (93) Predictions:
- a. In an iambic grouping (L \acute{L}) will lengthen to obtain the ideal iambic foot (L \acute{H})
 - b. In a trochaic grouping, however, since intensity matters, and not duration, matters maybe we don't expect (\acute{L} L) to alternate with (\acute{H} L).

9.1 Iambic lengthening

- (94) Hixkaryana, Carib language with 550 speakers in Brazil. Data originally from Derbyshire (1985).

★ Vowel length is not contrastive, so all these long vowels are derived by rule. What is it?

k ^w á:.<ja>	‘red and green macaw’
ne.mò:ko.tó:.<no>	‘it fell’
a.tjó:wo.<wo>	‘wind’
to.ró:.<no>	‘small bird’
àk.ma.tá:.<ri>	‘branch’
òw.to.hó:.<na>	‘to the village’
tòh.ku.r ^j é:ho.<na>	‘to Tohkurye’
tòh.ku.r ^j è:ho.nà:ha.fá:.<ka>	‘finally to Tohkurye’
nàk.nòh.jàtʃ.ke.ná:.<no>	‘they were burning it’
mì.hà:na.nìh.<no>	‘you taught him’
k ^h a.nà:nìh.<no>	‘I taught you’

9.2 Trochaic Shortening

- (95) Asymmetry: Trochaic lengthening is much rarer.
- (96) But, in moraic-trochee languages there is sometimes shortening of the strong syllable!
- (97) Hayes proposes that this is to allow more syllables to get included in feet: e.g., /LLLH/ → [(́L)L](́L) instead of [(́L)L]L(́H).
- (98) Trochaic shortening example (if time permits)
- a. In Fijian, vowel length is contrastive, but its distribution is limited. (Based on data from Schütz and analysis by Hayes.) Mostly loan words are shown below because, as in English, they’re the best source of long, monomorphemic words. [Fijian: Austronesian language from Fiji with 334,000 speakers]

★ What are the footing rules of Fijian?

láko	‘go’
tálo	‘pour’
βináka	‘good’
atómi	‘atom’
ⁿ dìkonési	‘deaconess’
prèsiténdi	‘president’
^m bàsikètepólo	‘basketball’
seǵáj	‘no’
^m basá:	‘bazaar’
ndòketá:	‘doctor’
palàsítá:	‘plaster’
mìnìsìtirí:	‘ministry’
terènisìsitá:	‘transistor’
ⁿ dàjrèkitá:	‘director’
ⁿ rè: ⁿ ré:	‘difficult’
^m bè:léti	‘belt’
taràwsése	‘trousers’
^m bèle ^m bò:tómu	‘bellbottoms’
mì:siniǵáni	‘machine gun’

★ Account for shortening in Standard Fijian:

^m bú:	‘grandmother’	^m bú-ŋgu	‘my grandmother’
tá:	‘chop’	tá-ja	‘chop-transitive-3 sg. obj.’
ⁿ ré:	‘pull’	ⁿ ré-ta	‘pull-trans.’
ǵaǵá:	‘lots of bad things’	ǵaǵá-ŋgu	‘my bad things’ ⁴
sì:βí-ta	‘exceed-trans.’	síβi	‘exceed’
ráj	‘see’	ráj-ǵa	‘see it’

10 Unbounded Stress Patterns

(99) Consider the following data from Selkup (an Ostyak-Samoyed language of West Siberia). Long voweled syllables count as heavy, everything else is light. (Halle and Clements 1983, Idsardi 1992, Walker 2000):

⁴Made-up form.

a.	[pɤnakisó:]	L L L H́	‘giant!’
b.	[ilisó:mit]	L L H́ L	‘we lived’
c.	[qó:kítit̪]	H́ L L	‘deaf’
d.	[qumó:qlilí:]	L H L H́	‘your two friends’
e.	[u:có:mit]	H H́ L	‘we work’
f.	[u:cikkó:qi]	H L H́ L	‘they two are working’
g.	[qúm̪in]	́ L	‘human being’ (gen.)
h.	[ám̪irna]	́ L L	‘eats’
i.	[qó ^l c̪impat̪]	́ L L L	‘found’

★ Does an Iambic/Trochaic analysis from either edge work?

★ Still, there is a clear pattern here. What is it?

★ In the Principles and Parameters framework, can you think of an additional parameter(s) that would get patterns of this type?

(100) Systems like Selkup are called *unbounded* stress patterns. All four types are well-attested:

- Rightmost Heavy otherwise Leftmost (Selkup)
- Leftmost Heavy otherwise Leftmost (Murik)
- Rightmost Heavy otherwise Rightmost (Golin)
- Leftmost Heavy otherwise Rightmost (Komi)

11 Some Further Reading on Stress

(101) Lots to read on stress: Liberman and Prince (1977), Hyman (1977), Prince (1983), Halle and Vergnaud (1987), Prince (1992), Idsardi (1992), Bailey (1995), Hayes (1995), Walker (2000), Gordon (2002), Elenbaas and Kager (1999), Hyde (2002)

References

Bailey, Todd. 1995. Nonmetrical Constraints on Stress. Ph.D. thesis, University of Minnesota. Ann Arbor, Michigan. Stress System Database available at <http://www.cf.ac.uk/psych/ssd/index.html>.

- Elenbaas, Nine and René Kager. 1999. Ternary rhythm and the lapse constraint. *Phonology* 16:273–329.
- Gordon, Matthew. 2002. A Factorial Typology of Quantity-Insensitive Stress. *Natural Language and Linguistic Theory* 20(3):491–552. Additional appendices available at <http://www.linguistics.ucsb.edu/faculty/gordon/pubs.html>.
- Halle, Morris and G. N. Clements. 1983. *Problem Book in Phonology*. Cambridge, MA: MIT Press.
- Halle, Morris and Jean-Roger Vergnaud. 1987. *An Essay on Stress*. The MIT Press.
- Hayes, Bruce. 1995. *Metrical Stress Theory*. Chicago University Press.
- Hyde, Brett. 2002. A Restrictive Theory of Metrical Stress. *Phonology* 19:313–319.
- Hyman, Larry. 1977. On the nature of linguistic stress. In *Studies in stress and accent: Southern California Occasional Papers in Linguistics 4*, edited by Larry Hyman. Dept. of Linguistics, University of Southern California.
- Idsardi, William. 1992. The Computation of Prosody. Ph.D. thesis, MIT.
- Jacobs, Haike. 1989. Nonlinear Studies in The Historical Phonology of French. Ph.D. thesis, Katholiek Universiteit te Nijmegen.
- Ladd, Robert. 1996. *Intonational Phonology*. Cambridge University Press.
- Lieberman, Mark and Alan Prince. 1977. On Stress and Linguistic Rhythm. *Linguistic Inquiry* 8:249–336.
- Mester, Armin. 1992. The quantitative trochee in Latin. *Natural Language and Linguistics Theory* 12(1):1–61.
- Prince, Alan. 1983. Relating to the Grid. *Linguistic Inquiry* 14(1).
- Prince, Alan. 1992. Quantitative Consequences of Rhythmic Organization. *CLS* 26:355–398. Parasession of the Syllable in Phonetics and Phonology.
- Walker, Rachel. 2000. Mongolian Stress, Licensing, and Factorial Typology. ROA-172, Rutgers Optimality Archive, <http://roa.rutgers.edu/>.