Class 7: Structure above the segment I

To do
- Nanti assignment (on last week's material) is due Friday
- Next reading McCarthy & Prince 1994 (due Tuesday)
- Project: have 1st meeting with me by the end of next week

Overview
Let's turn our attention from processes to the representations they manipulate, starting with structure above the segment. We'll consider arguments for having skeleta, moras, syllables, grids, feet, prosodic words...

1 Representations in SPE

Very simple: sequence of feature matrices

$$\begin{bmatrix}-\text{segmental}\\+\text{WB}\\-\text{FB}\end{bmatrix}\begin{bmatrix}+\text{seg}\\+\text{cons}\\+\text{dors}\\-\text{voice}\\-\text{nas}\\-\text{son}\end{bmatrix}\begin{bmatrix}+\text{seg}\\-\text{cons}\\+\text{dors}\\-\text{hi}\\+\text{low}\\-\text{back}\\-\text{round}\end{bmatrix}\begin{bmatrix}+\text{seg}\\+\text{cons}\\+\text{cor}\\-\text{voice}\\-\text{nas}\\-\text{son}\end{bmatrix}\begin{bmatrix}-\text{seg}\\+\text{WB}\\-\text{FB}\end{bmatrix}$$

2 Reasons to add skeletal structure

$$\begin{array}{ccc}\text{C} & \text{V} & \text{C}\\ | & | & |\end{array}$$
$$\begin{bmatrix}+\text{dors}\\-\text{voice}\\\ldots\end{bmatrix}\ldots\text{etc.}$$

- <u>Persistence of skeletal structure</u>
  Bakwiri (aka Mokpwe, Niger-Congo language from Cameroon with 32,200 speakers) syllable-reversing language game (Bagemihl 1989, data from Hombert 1973):

normal	*reversed*	
lìyé	yèlí	'stone'
lùùŋgá	ŋgààlú	'stomach'
ẓééyà	yááẓè	'burn'
ʔézẹ̀è	ẓeʔèè[1]	'is is not'
lìòβá	βààlíó	'door'

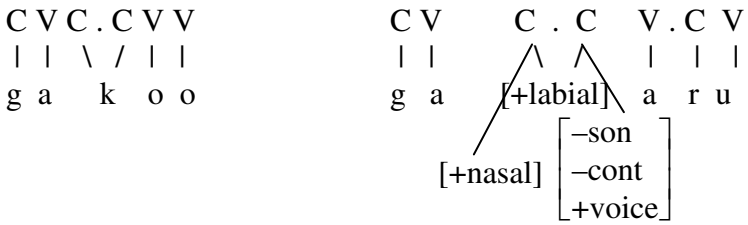
  - Let's draw before-and-after representations with a skeletal tier

[1] I don't know what's up with the tone on the first syllable; maybe it's a typo.

- Licensing of a feature by one of its multiple associations

Japanese Ito 1986: place features in a coda are OK only if they belong to a place-assimilated nasal or the first half of a geminate .

Assume a requirement that place features be associated to an onset/prevocalic C (they can have additional associations too):



- Geminate inalterability: shared structure is special

Consider the linear versions of some optional rules from Toba Batak, from Hayes 1986b (aka Batak Toba, Austronesian language from Indonesia with 2 million speakers):

glottal formation $\begin{bmatrix} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{bmatrix} \rightarrow$ ʔ / __ C

/ganup taɔn/	→	ganuʔ taɔn	‘every year’
/dɔhɔt lali i/	→	dɔhɔʔ lali i	‘and the hen-harrier’
/halak batak/	→	halaʔ batak	‘Batak person’
/lap piŋgɔl/	→	laʔ piŋgɔl	‘wipe off the ear’
/maŋihut taɔn/	→	maŋihuʔ taɔn	‘according to the year’
/halak kɔrɛa/	→	halaʔ korɛa	‘Korean person’

n-h *rule* n h → k k

/maŋan halak i/	→	maŋak kalak i	

denasalization $\begin{bmatrix} \text{C} \\ +\text{nas} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{nas} \\ -\text{voice} \end{bmatrix} / \_\_ \begin{bmatrix} \text{C} \\ -\text{voice} \end{bmatrix}$

/maŋinum tuak/	→	maŋinup tuak	‘drink palm wine’
/manaŋ pulpen/	→	manak pulpen	‘or a pen’
/holom saɔtik/	→	holop saɔtik	‘somewhat dark’
/mananɔm piriŋ/	→	mananɔp piriŋ	‘bury a dish’
/mamɛrɛŋ kalabbu/	→	mamɛrɛk kalabbu	‘look at a mosquito net’

h-*assimilation* [–voice] h → 1 1 (1 2)

/marisap hita/	→	marisap pita	‘let us smoke’
/dɔhɔt halak/	→	dɔhɔt talak	‘and a person’
/modom halak i/	→	modop palak i	‘the man is sleeping’
/dibɛrɛŋ halak i hɔrbɔ i/	→	dibɛrɛk kalak i hɔrbɔ i	‘the man saw the buffalo’

- There is an ordering solution here under the linear theory: what is it?

- More data—can we patch up the linear account to handle them?

/diktatɔr/[2]	→	diʔtatɔr	'dictator'
/rɔtrɔt/	→	rɔʔrɔt	'to knock down'
vs.			
/dɛkkɛ/	→	dɛkkɛ	'fish'
/pittu/	→	pittu	'door'
/aŋsa/	→	aksa	'fish'
vs.			
/adat+ta/	→	adaʔta	'our custom'
/suddut+ta/	→	suddu ʔta	'our generation'

Hayes's solution (spelling it out explicitly gets more complex—see the paper): assimilation creates a shared structure, not eligible for the glottal-formation rule.

- Let's try it.

See also Schein & Steriade 1986, Hayes 1986b.

3 Reasons to add syllables?

- They can explain basic C/V phonotactics well.

Yawelmani Yokuts (Kisseberth 1970, Penutian language of California, possibly no speakers) seems to require a constraint $*\begin{Bmatrix}\#\\C\end{Bmatrix} C \begin{Bmatrix}\#\\C\end{Bmatrix}$.

- How could we rephrase this if the theory includes syllables?

- They can explain subtler phonotactics too (see Steriade 1999 for classic references):
  - Certain contrasts are licensed only in onsets (place, voicing,...)
  - Sonority tends to rise within an onset, fall within a coda

But Steriade 1999 argues that these phenomena are better explained in a way that sticks closer to the phonetics:

- Yokuts: all consonants must be V-adjacent
- Prevocalic position is a better place for certain contrasts (place, voicing)
- (I'll refer you to Steriade for the sonority-contour material.)

⇨Praat demo

And, Steriade argues, sometimes syllables make the wrong prediction.

- Retroflex consonants' place is best cued in the transition from the preceding V, not the transition to the following V.
  - There are languages where a retroflex is allowed only in a coda!

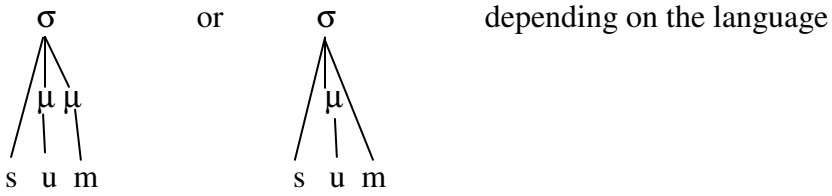
- Things we might still want syllables for?

[2] How do we know this is the underlying form? Because in careful speech, all these rules are optional.

4 What are moras? Review

A *mora* is an abstract unit of duration[3] that has been proposed for dealing with footing and stress assignment in so-called "quantity-sensitive" languages.
It's the difference between a light syllable and a heavy syllable.

- What gets a mora?
  - Onsets usually don't get any (but see Topintzi 2006)
  - A nucleus vowel almost always gets one (though in some languages, schwa gets no mora).
  - A long vowel or diphthong (2 vowels in the same nucleus) usually gets two.
  - A coda consonant may get one, depending on the language—and it some languages, only certain coda consonants get one



- Syllable weight
  1 mora: light syllable
  2 moras: heavy syllable
  3 moras: superheavy syllable
  - How could a syllable have 3 moras?

5 Reasons to add moras

- <u>Syllables with more moras often attract stress</u>, leading to this constraint (Prince 1990):
  WSP ("weight-to-stress principle"): a heavy syllable must be stressed

Before moras you had rules like V → [+stress] / __ C{C,#}
Doesn't capture the typology (why not V → [+stress] / __ CV instead?)

- <u>Compensatory lengthening</u> (Hayes 1989)

Latin historical change	*kas.nus >	ka:.nus 'gray'
	*kos.mis >	ko:.mis 'courteous'
	*fi.des.li.a >	fi.de:.li.a 'pot'
Turkish free variation	sav.mak →optionally	sa:.mak 'to get rid of'
but	da.vul →optionally	da.ul 'drum'

- Draw the moras and syllable structure for [sav.mak] and [da.vul]. Let's ponder why deletion leads to lengthening in one case but not the other.

[3] or total acoustic energy, or total acoustic energy weighted with some frequencies counting more than others. See Gordon 2002,

Greek (East Ionic)	*woi.kos > oi.kos	‘house’
	*ne.wos > ne.os	‘new’
	*od.wos > oː.dos	‘threshold’

- Draw the moras and syllable structure for [woi.kos], [ne.wos], [od.wos], and ponder.

Middle English (originally from Minkova 1982*)*	ta.lə > taːl	‘tale’

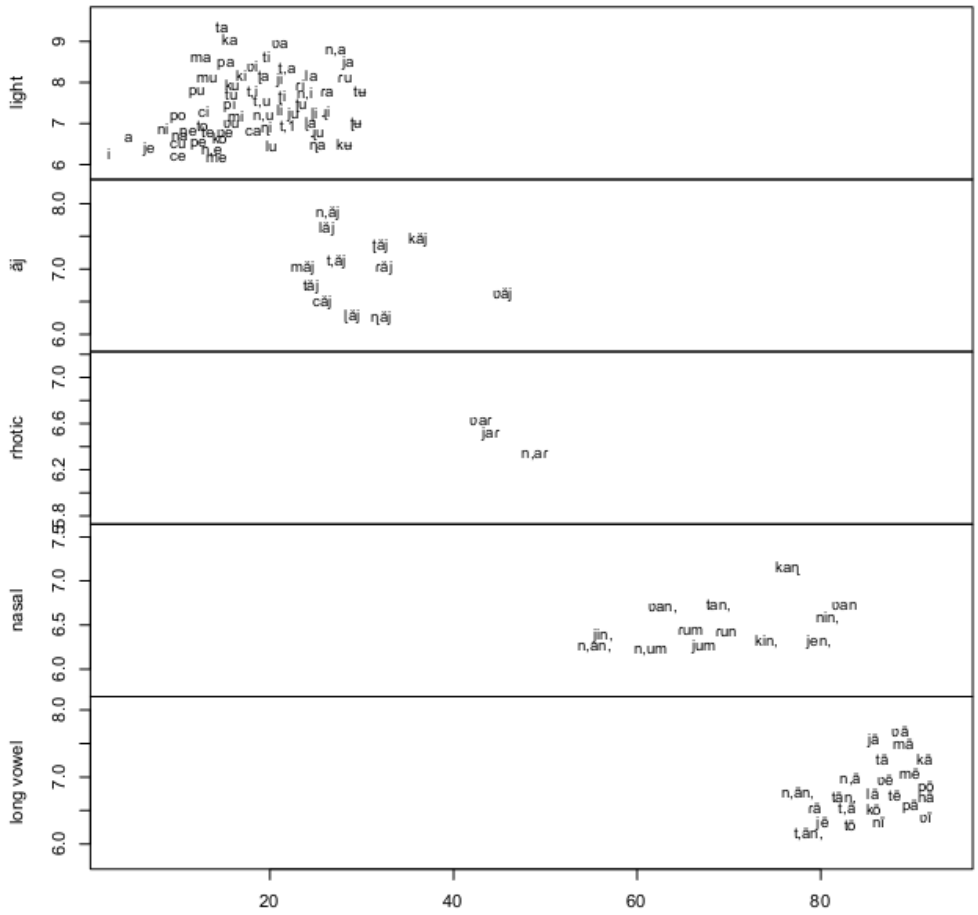
- We have to ignore several complications, but we can get the basic idea by drawing [ta.lə]

Unattested cases	sa → aː
	sla → saː

- Why don’t these occur?

But: Ryan 2011a; Ryan 2011b shows that language can make many more than 2 or 3 weight distinctions

- Tamil: using sophisticated statistical measures over a huge verse corpus, Ryan finds 5 partly-overlapping weight classes



horizontal axis: percentage of the time each syllable type acts as though heavy in verse.

vertical axis: log frequency of each type (you can ignore it).

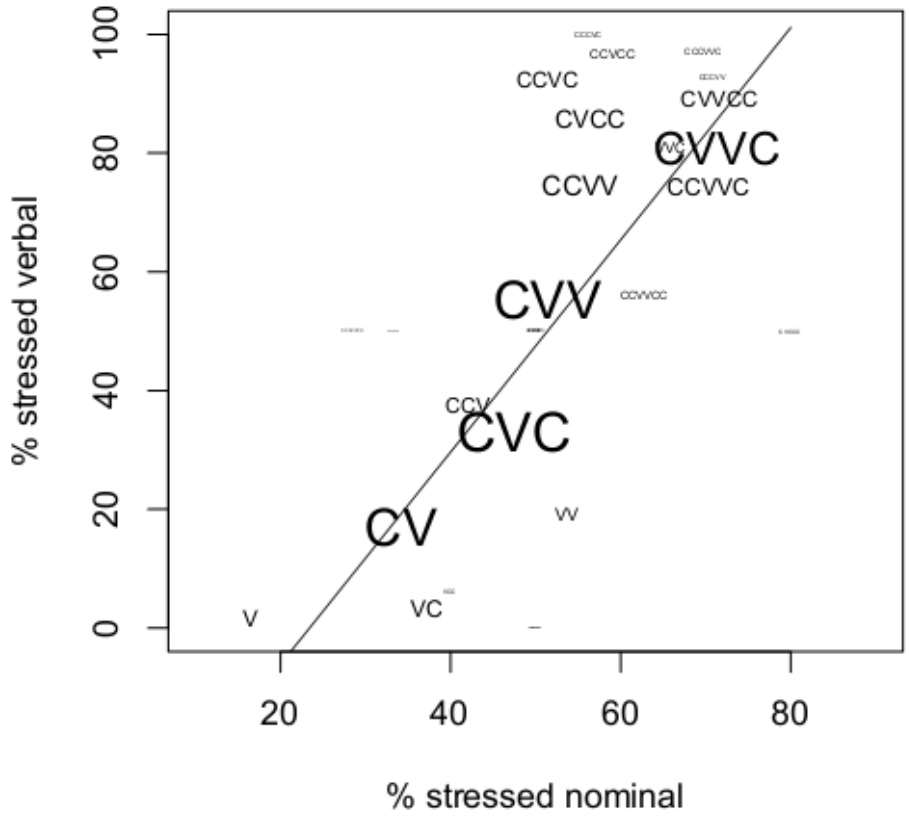
Figure 14: Figure 13 filtered into five phonological classes.

(Ryan 2011a p. 21)

- Later he finds more and more categories (here and for other languages)
- The categories also don't behave as though evenly spaced

→ In versification and lexically-variable stress (English real and fake words), it seems more like you can attach a real number to each syllable, like "0.81".

Here's the English real-word data:



Size of font indicates frequency.

Notice that more-complex onset leads to more stress.

(Ryan 2011a, p. 179)

6 Reasons not to treat stress as a feature

- Other features (usually) don't shift from segment to segment based on distance from a word edge:

órigin	oríginal	orìginálity
phótogràph	photógrapher	phòtográphic

- Other features (usually) don't act at long distances across other instances of that feature:
  Mìssissíppi vs. Míssissìppi législàtors

- Languages don't require every content word to have at least one + value of other features (except maybe [syllabic], which, in the CV-skeleton theory, is not a feature anyway).

- For just about every other feature, there is some language where it assimilates—but I know of no rules of stress assimilation, only stress dissimilation.

7 Reasons to handle stress with a metrical grid

Stress relations are often represented as a *grid* (Liberman 1975). Rows (a.k.a. 'layers') represent degrees of stress; columns are associated with stress-bearing units (syllables, typically).

				x		
x				x		
x		x		x		
x	x	x	x	x	x	
re	con	ci	li	a	tion	(example from Hayes)

Grids are subject to the inviolable **Continuous Column Constraint**: for every grid mark (except on the bottom layer) there must be a grid mark in the same column on the layer below.

- Locality

English phrasal stress rule (a.k.a. nuclear stress rule): place main stress on last word of phrase[4]

- But sometimes main stress ends up several syllables from the end of the phrase—makes for an awkward rule
- Example from Hayes: *hypothètical ímitators*, which could also perhaps be *hy̗pothetical ímitators*.

Grid version of the rule is local:

$$\begin{bmatrix} \\ x\ x \end{bmatrix} \rightarrow \begin{bmatrix} x \\ x\ x \end{bmatrix}$$

= "if the top layer of the grid has exactly two marks, add another mark to the second one"

- Any amount of white space is allowed between and on either side of *x*s on the same layer when matching representations up to the structural description
- The structural description could match any (adjacent) rows of the grid

o Draw grids for *hypothetical* and *imitators* in isolation; put them together and apply this rule.

- The optional English rhythm rule (Prince 1983): really an interaction between a constraint NoClash and a rule Move-X.

NoClash: * x x (if two grid marks are adjacent on their layer, the grid marks under x x them can't also be adjacent on their layer)

Move-X: Move one grid mark along its layer (triggered by No-Clash)

English-specific detail: only leftward movement is allowed here.

o Draw the grids for *Mississippi* and *legislators*. If you put them together, is No-Clash violated?
o Apply Move-X if necessary—where can X move to without violating the Continuous Column Constraint?
o In what way might this operation appear non-local? In what way is it local?

[4] This can be overridden by focus. Also, watch out for compounds.

- The rich get richer: in the rhythm rule, Prince notes that the stress retracts onto the strongest preceding syllable. Here are some of Hayes's examples...

  - Draw grids for *Sunset Park* and *Zoo*, and then put them together and apply Move-x to resolve/alleviate the clash. Where can the moved *x* land?
  - Let's use the rhythm rule to figure out grids for *totalitarian tendencies* (more than one possible outcome?) and *Constantinople trains*

- And the poor get poorer (Hayes): Consider the derivation of *paréntal* from *párent*. When *–al* is added, assume that stress rules add stress to the new penult (*páréntal*). Then main stress is assigned (*pàréntal*).

  - Draw the grid for *pàréntal*. What constraint is now violated? Can Move-X help?
  - Assume a rule 'Delete (one) *x*' that can be triggered by constraint violation (though not by NOCLASH, apparently). What options do we have for applying that rule?

8 Reasons to add feet

- Minimality: size restrictions on content words

Estonian (Prince 1980): ≥ two moras, word-final C doesn't count

/tänava/	tänav		'street (nom.sg.)'
/konna/	kon:n		'pig (nom. sg.)'
/kana/	kana (*kan)	*V-deletion blocked*	'chicken (nom. sg.)'

Mohawk, Kahnawake dial. (Iroquoian, Canada & US, 3,760 speakers; Michelson 1981): ≥ 2 sylls.

/k+tats+s/	**í**ktats	'I offer'
/hs+yaʔks+s/	**í**hsyaʔks	'you are cutting'

These look suspiciously like feet: maybe moraic trochees for Estonian ((LL) or (H)), syllabic trochees for Mohawk (σσ)

Hayes 1995: Can we just say that "every word must be able to undergo the stress rule" (without invoking feet in the stress rule)? Try it for Mohawk, which has penultimate stress.

From Hayes 1995: Pitta-Pitta [Australian, prob. no speakers]—words also must be ≥ 2 sylls.[5]

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

  - What would be the main stress rule for Pitta-Pitta?
  - Does our rule exclude subminimal words (*ka)? What about other formulations of the rule?

But: There is much debate about how well minimum-word requirement really lines up with foot shape crosslinguistically: see Golston 1991, Garrett 1999, Blumenfeld 2011.

[5] Data warning: To get these examples I took words from Blake's "Pitta Pitta wordlist" (coombs.anu.edu.au/SpecialProj/ASEDA/docs/0275-Pitta-Pitta-vocab.html), which doesn't mark stress, and then added in the stresses according to Hayes' reporting of Blake's (1979) description.

- Trochaic languages are more common than iambic; with feet, we can characterize one parameter setting as more common (doesn't explain that fact, though).

- Various consonantal rules 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 reported to have no secondary stress). See González 2002 for a case of this and a case of something even more complicated.

- Expletive infixation in English (McCarthy 1982):
  Mo(nònga)-(fucking)-(héla)
  (Òs)-(fucking)-(wégo)
  (Àpa)-(fucking)-(làchi)(cóla), (Àpa)(làchi)-(fucking)-(cóla)
  (Tàta)ma-(fucking)-(góuchi) ~ (Tàta)-(fucking)-ma(góuchi)

  but can it be described in terms of lapse and clash?

- Latin enclitic stress (Steriade 1988; Jacobs 1997):

  Latin stresses the penult if it's heavy, otherwise the antepenult (data from Jacobs/Hayes):

(cá.me)<ram>	(ár.bo)<rem>	pe(dés)<trem>	vo(lup)(táː)<tem>
(sí.mu)<laː>	do(més.ti)<cus>	a(míː)<cus>	(liː.be)(raː.ti)(óː)<nem>

  But, it's different when you add an enclitic: Steriade proposes that

(í)<ta>	'so'	(i)(tá)=<que>	'and so'	*(í.ta)=<que>
(mú)<sa>	'Muse'	(mu)(sá)=<que>	'and the Muse'	*(mú.sa)=<que>
(líː.mi)<na>	'thresholds'	(liː.mi)(ná)=<que>	'and the thresholds'	*(liː)(mí.na)=<que>
(no)<bis>	'us'	(no)(bís)=<cum>	'with us'	
		(no)(bis)=(cúm)=<que>	'and with us'	

  Steriade's solution: when a clitic is attached, only previously unfooted material can be footed: old feet can't be readjusted (let's step through a couple of these)

  To deal with the following data, Jacobs proposes that not only final syllables, but also final enclitics are extrametrical:

(íd)	'this'	(íd)=<circoː>	'therefore'	*(id)=(cír)<co>
		(id)=(cir)(cóː)=<que>	'and therefore'	
(quáː)	'which'	(quáː)=<propter>	'wherefore'	*(quaː)=(próp)<ter>
e(áː)	'there'	e(áː)=<propter>	'therefore'	*e(aː)=(próp)<ter>
		e(aː)=(prop)(tér)=<que>	'and therefore'	
(ú)<bi>	'where'	(u)(bí)=<li.bet>	'wherever'	

  - Bring on the dissent and counter-analysis for all of these...

- Asymmetric foot inventory

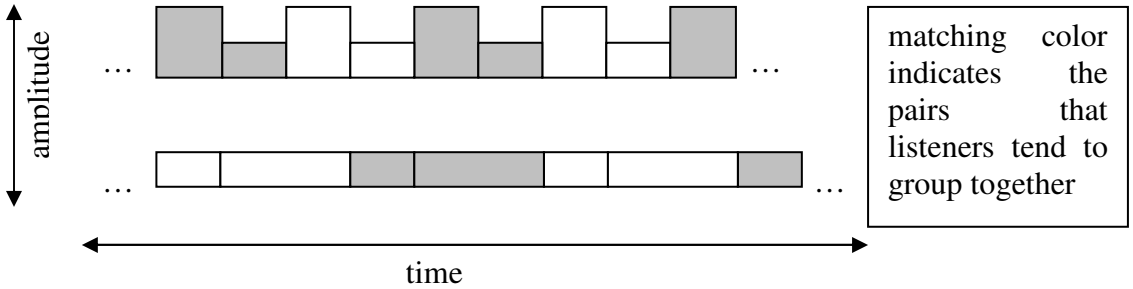
	trochees	*iambs*
quantity-insensitive	**attested**	unattested
quantity-sensitive	**attested: moraic (LL), (H)**	**attested: "uneven" (LH), (H), (LL)**

Hayes (1995) argues, through an extensive typological survey, that these 3 are the only foot types. There are claimed to be no languages with syllabic iambs.

[Altshuler 2006 gives a convincing counterexample—Osage—complete with acoustic data: there is a length distinction in vowels, but still stress on all even-numbered syllables, regardless of length. There are words with stress on all the odd-numbered syllables, suggesting trochees, but Altshuler argues from suffixation that those are exceptions; the language is iambic by default.]

9 Why the asymmetry?

Rice 1992, ch. 5 Reviews and replicates Woodrow 1909, 1911, 1951b.[6] Schematically,



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

Subjects were played various binary, 7-repetition sequences of tones varying in tone duration, intertone pause duration, and tone pitch (Rice didn't test intensity; Woodrow did) and had to say whether each was weak-strong or strong-weak.

Percent trochaic (strong-weak) response (Rice p. 195)

	Stimulus 1	Stimulus 2	Stimulus 3	
Group 1	59.62	67.31	71.15	equal duration, equal pitch, equal pause
Group 2	46.15	38.46	32.69	alternating duration, equal pitch, equal pause
Group 3	57.69	50.00	59.62	equal duration, equal pitch, alternating pause
Group 4	51.92	57.69	44.23	equal duration, alternating pitch, equal pause

difference increases ----->
(except Group 1, where duration changes)

=> The duration-alternating stimuli (Group 2) produce the most "iambic" responses, more strongly so as the duration difference increases.

[6] I tried to read Woodrow 1909 but in the time I could spare for the task it was just about impenetrable, so unfortunately I have none of his raw results to share with you. Apparently Fraisse 1963 is a good source on classic time-perception research too, if you're interested.

Hayes 1995 cites also

- similar evidence from musicians' judgments Cooper & Meyer 1960: "Durational differences...tend to produce end-accented groupings; intensity differentiation tends to produce beginning-accented groupings" (p. 10; as quoted by Hayes p. 80)
- a study of Swedish poetry Fant, Kruckenberg, & Nord 1991 in which…
  - reciters produced greater durational contrasts in iambic verse than in trochaic
  - musicians transcribing verse into musical notation "likewise reflected the pattern of the law in their choice of note values"
  - 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)

➔ "Iambic/Trochaic Law (Hayes 1995, p. 80)
a. Elements contrasting in intensity naturally form groupings with initial prominence.
b. Elements contrasting in duration naturally form groupings with final prominence."

10 A consequence of the asymmetry: trochaic shortening

Middle English. This is apparently a bit controversial, but here's the standard story (Mellander 2004):

Assume footing as shown—I'm leaving as open/unsolved why these footings (issues: is it extrametricality or non-finality? which consonants are moraic?)

- How can we analyze these? Draw in the feet.

(súːð)	'south'	(sú.ðer)<ne>	'southern'
di(víːn)	'divine'	di(ví.ni)<tie>	'divinity'

I couldn't get clear Middle English data easily, so here are some Modern English examples that reflect the same phenomenon (whether or not it's now synchronically real), from Prince 1990, pp. 13-14, with a couple of substitutions:

- Analysis from above should extend straightforwardly:

(óː)mən	'omen'	(ámə)nəs	'ominous'
(séːn)	'sane'	(sǽnə)ɾi	'sanity'

- How do these work? (These examples show that "trisyllabic shortening" is a bit of a misnomer) [Prince, following Myers 1987, says that the suffix *–ic* is, exceptionally, not extrametrical.]

(kóːn)	'cone'	(ká.nɨk)	'conic'
(májm)	'mime'	(mí.mɨk)	'mimic'

- Can we explain the different pronunciations of the prefix? (Never mind why the final syllable is now getting footed—probably something to do with the = boundary)

(ɹɛ́.bəl)	'rebel'	(ɹɪ́)(bèːt)	'rebate'
(ɹɛ́.kɚd)	'record' (noun)	(ɹɪ́)(flɛ̀ks)	'reflex'
(ɹɛ̀.zɨ)(dɛ́n.ʃəl)	'residential'	(ɹì)(læ̀k)(séː)ʃən	'relaxation'
(pɹɛ́.fəs)	'preface'	(pɹɪ́)(fɛ̀kt)	'prefect'
(pɹɛ́.lət)	'prelate'	(pɹɪ́)(lèːt)	?
(pɹɛ́.məs)	'premise'	(pɹɪ́)(fɪ̀ks)	'prefix'
(pɹɛ̀.zən)(téː.ʃən)	'presentation'	(pɹì)(mɛ̀.ɹɨ)(téː)ʃən	'premeditation'

To sum up

- We've seen some of the classic arguments for adding various types of representational structure above the segment.
- We've also seen some of the doubts.
- Next time: arguments for one last piece of structure, the **prosodic word**.

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