Linguistics 219 Spring 2020
Phonological Theory III B. Hayes

Class 13, 5/12/2020: Phonetics of Weight II

1. Assignments

- Read: Matthew Gordon (2005) A phonetically-driven account of onset-sensitive stress. *Natural Language & Linguistic Theory* 23:595–653. On course web site.
- Homework #4 will be handed out on Thursday.

2. Where we are in general

- Phonetically based phonology, with an emphasis on syllable weight

3. Today

- Exercises on syllable weight languages
- Weight typology
- Theories of phonetic influence

WARM-UP EXERCISE: PIRAHÃ STRESS

4. References

- Amazonas State of Brazil; 350 speakers; affiliation unclear
- Ur-source: work of Dan and Karen Everett

Everett, Daniel. 1988. 'On Metrical Constituent Structure in Pirahã Phonology', *Natural Language and Linguistic Theory* **6**, 207–246.

Everett, Daniel and Keren Everett. 1984. 'Syllable Onsets and Stress Placement in Pirahã', *Proceedings of the West Coast Conference on Formal Linguistics* **3**, 105–116.

Everett, Keren 1998. 'The Acoustic Correlates of Stress in Pirahã', *The Journal of Amazonian Languages* **1**, 104–162.

- Everett was befriended by Peter Ladefoged, who followed him back to the Amazon and measured.
- Ladefoged delegated interpretation to phonetician/phonologist Matt Gordon.
  - Matthew Gordon (2005) A phonetically-driven account of onset-sensitive stress. *Natural Language & Linguistic Theory* 23:595–653.

5. Claim to fame

- An elaborate hierarchy of syllable weight

In this system, both rime weight and onset weight are relevant. Vowel length is the dominant weight criterion, since a long voweled syllable, regardless of onset, is weightier than a syllable containing a short vowel. If, however, two rimes are equivalent in vowel length, onset type acts as a tiebreaker. Pirahã stress examples (from Everett and Everett 1984, Everett 1988) appear in (1). (Low tone is unmarked.)

(1) Pirahã stress

KVV > GVV: ˈhoa.gái 'come', ˈkaa.gai 'word', ˈkaí.bai 'monkey'

GVV > VV: poo.ˈgái.hi.aí 'banana', ho.aa.ˈgai 'type of fruit', ˈgao.ii 'proper name'

VV > KV: pia.hao.gi.so.ˈai.pi 'cooking banana', ho.ˈaí.pi 'type of fish', pí.ˈai 'also'

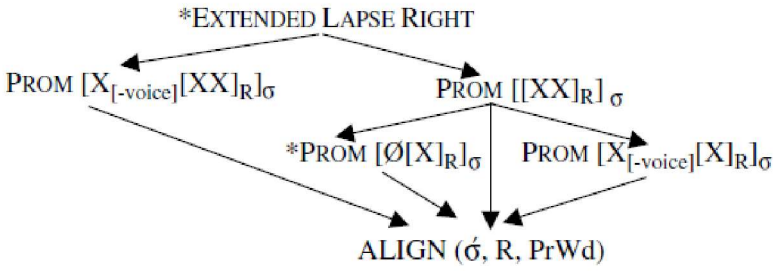
KV > GV: ˈʔa.ba.gi 'toucan', ti.ˈpo.gi 'bird species', ˈʔí.bo.gi 'milk'

Rightmost in case of tie: paó.hoa.ˈhai 'anaconda', bai.tói.ˈsái 'wildcat'

6. Exercise

- Develop a simple OT grammar that predicts correct stress in all of the forms given just above.

7. Compare with Gordon's grammar



8. An English parallel

- Nanni, Debbie L. "Stressing words in-ative." *Linguistic Inquiry* (1977): 752-763.
- Some pastes of Nanni's data:

(5)

a. altérnative	—	alternAte + ive
contémplative	—	contemplAte + ive
demónstrative	—	demonstrAte + ive
compénsative	—	compensAte + ive
adúmbrative	—	adumbrAte + ive
b. génerative	—	generAte + ive
íterative	—	iterAte + ive
ejáculative	—	ejaculAte + ive
législàtive	—	legislAte + ive
remúnerative	—	remunerAte + ive
appréciative	—	appreciAte + ive
írritàtive	—	irritAte + ive
invéstigàtive	—	investigAte + ive

(10)

ínnovÀtive	—	*innovətive
quálitÀtive	—	*qualitətive
invéstigÀtive	—	*investigətive
admínistrÀtive	—	*administrətive
législÀtive	—	*legislətive
ággravÀtive	—	*aggravətive
írritÀtive	—	*irritətive
intérpretÀtive	—	*interpretətive
elúcidÀtive	—	*elucidətive

(11)

nominative	initiative	manipulative
imaginative	palliative	terminative
ejaculative	cumulative	operative
iterative	agglutinative	remunerative
agglomerative	generative	

9. This is probably -ative-specific

- My search of similar words not in -ative found equal numbers of sonorants and obstruents.

participle	tabernacle
nomenclature	logarithm
legislature	enthusiasm
architecture	necromancer
microcosm	oleander
cataclysm	matriarchy
alabaster	patriarchy
filibuster	hierarchy
pedagogy	ignominy
demagogy	ceremony
oligarchy	alimony
melancholy	acrimony
taxidermy	matrimony
controversy	patrimony
difficulty	parsimony
apoplexy	testimony
orthodoxy	epilepsy

10. Exercise

Derive: alternative, nominative, imitative, logarithm

11. A more subtle parallel

- Onset effects in English stress are subtle.
- The Nanni generalization is found in what is essentially a minimal pair environment.

BRANCHING ONSETS AS MODEST SOURCES OF WEIGHT

12. Kelly on English

- Source
  - Michael H. Kelly (2004) Word onset patterns and lexical stress in English. *Journal of Memory and Language* 50: 231–244.
- (See also his prescient work with Martin

- Michael H. Kelly and Susanne Martin (1994) Domain-general abilities applied to domain-specific tasks : Sensitivity to probabilities in perception, cognition, and language. *Lingua* 92: 105-140.)

- Basic generalization: the more consonants an English disyllable begins with, the more likely it will have initial stress.

- Corpus study (electronic lexicon):

Number of onset consonants	Number trochaic	Number iambic	Proportion trochaic
0	441	806	.35
1	2862	295	.69
2	783	158	.83
3	40	1	.98

  - This is *superposed* on the well-known noun-verb difference (*SPE*); so there is ganging:

Number of onset consonants	Number trochaic	Number iambic	Proportion trochaic
Nouns	2411	646	.79
0	274	102	.73
1	1689	475	.78
2	429	68	.86
3	19	1	.95
Verbs	648	1228	.35
0	43	485	.08
1	468	667	.41
2	129	76	.63
3	8	0	1.00
Adjectives	966	183	.84
0	107	90	.54
1	632	81	.89
2	214	12	.95
3	13	0	1.00

- Playing with this a bit. e.g. 18/4155 in my toy English database start with [str] in trochaic words

  straddle, straggle, straggler, straighten, stranded, stranger, strangle, stratum, streamer, strengthen, stricken, stricture, strident, stringent, stroller, structure, struggle

  0/1265 in iambic words, and *stramoyne*, *stradelle*, *stralipse* seem a little odd.

- Kelly's wug test: "how would you stress this?" Pairs with C-, CC-, splitting subjects so no one sees both in the same pair.

No prefix	Prefix
beldop–breldop	colvane–crolvane
bolay–brolay	conzee–cronzee
botest–blotest	covact–clovact
corlax–clorlax	formand–flormand
dolmak–drolmak	fornay–frornay
feslak–freslak	pernew–spernew
fonjoob–flonjoob	pernor–spernor
fontrain–flontrain	renell–drenell
garlag–glarlag	telmate–trelmate
menlee–smenlee	telpez–trelpez
mernak–smernak	
pinjub–plinjub	
ransfoe–gransfoe	
rignaz–grignaz	
roncerp–troncerp	
ronvoon–gronvoon	
seldiz–sneldiz	
torvoot–tworvoot	
wispay–swispay	
bendict–brendict	
bontoon–brontoon	
delpeen–drelpeen	
delray–drelray	
deltain–dreltain	
delvoe–drelvoe	
lesbect–klesbect	
pamdeen–plamdeen	
peltact–pleltact	
pomset–plomset	
ponveen– plonveen	
pelcrack–prelcrak	
ponsect–pronsect	
sestrow–slestrow	
merset–smerset	
pemit–spemit	
solray–spolray	
torpez–strorpez	

- Result:

Mean Proportion of trochaic stress judgments in study 2 as a function of pseudoword onset (C or CC) and prefix on C pseudowords (present or absent)

Prefix	Onset structure	
	C	CC
Present	.67	.71
Absent	.60	.80

  - Note the rather larger effect in non-prefixed forms.

WEIGHT TYPOLOGY

13. The core

- A universal hierarchy: CVV > CVC > CV
- Latin cutoff: CVV+CVC > CV
- Khalkha cutoff: CVV > CVC + CV
- Cherokee/Finnish cutoff: CVV > CVC > CV

14. The periphery

- Lowness or peripherality of vowels makes weight
- Sonorancy of codas makes weight
- Obstruency (!) of onsets makes weight
- Branchingness of codas and onsets makes weight

15. Some research questions

- Why do all these criteria all work consistently across languages?
- Why are the core criteria more robust (overriding, better attested) than the peripheral criteria?
- Why do different phonological processes tend to select different criteria of weight?

PRELIMINARY: NORMALIZATION IN PHONETICALLY-BASED PHONOLOGY

16. The need for normalization

- Phonetic experience is continuous and variegated.

- What is "phonetically hard" varies continuously from token to token.
- So, if the scheme of phonetic explanation via constraint is to work, there must be a workable scheme of computing **characteristic** phonetic difficulty.

17. Phonetic maps

- Articulation: Hayes (1999) on voicing difficulty:

Landscape of Difficulty for Voiced Stops: Three Places, Four Environments

	b	d	g	
[-son] ___	43	50	52	
# ___	23	27	35	
[+son, -nas] ___	10	20	30	
[+nas] ___	0	0	0	contour line: 25

- Perception: Steriade on the P-map:
  - From D. Steriade (2001) Directional asymmetries in place assimilation: a perceptual account. In E. Hume and K. Johnson (eds.) *Perception in Phonology*, Academic Press.

(12) Hypothetical P-map fragment: similarity of apical pairs by context

• letter size reflects hypothesized similarity: bigger letter = less similar pair

	V_V	V_#	V_C	#_V	C_V	C_C
s/ʂ	s/ʂ	s/ʂ	s/ʂ	s/ʂ	s/ʂ	s/ʂ
t/ʈ	t/ʈ	t/ʈ	t/ʈ	t/ʈ	t/ʈ	t/ʈ
n/ɳ	n/ɳ	n/ɳ	n/ɳ	n/ɳ	n/ɳ	n/ɳ

ELEMENTS OF A PHONETICALLY-GROUNDED THEORY OF WEIGHT

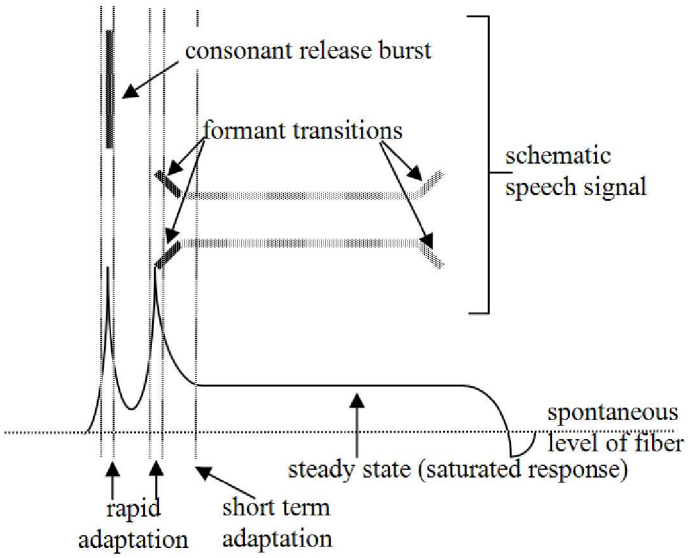
18. Process specificity should be a consequence

- It stands to reason that vowel duration, or VR rhyme duration, would matter to tone.
- Indeed, in the three known languages where a coda obstruent makes a syllable heavy for purposes of tone, it seems to be due to vowel lengthening in the non-contrastive environment of a closed syllable.

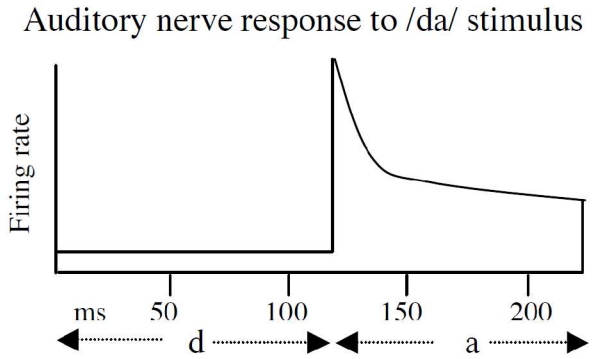
19. Elements that evidently make syllables sound more prominent for stress

- Duration
- Sonority (primarily V vs. C, but also differences among V's and C's)

- The "suddenly-loud" effect of auditory perception.
  - from Richard Wright (2004) Perceptual Cue Robustness and Phonotactic Constraints: Rethinking Sonority. In Hayes/Kirchner/Steriade, *Phonetically Based Phonology*



- Gordon's schematized version has a gentle downward slope during the main part of the vowel:



- Either way, it implies the striking effect: ***less* sonorous consonants imply greater weight than more sonorous ones**.
- Gordon measures perceptual salience of syllables by integrating over sonority, with a boost for post-quiet things — the quieter, the greater the boost.
  - The unit of measure emerges as the **decibel-millisecond**.

20. Phonological changes that might be thought of as weight-enhancing under Gordon's view

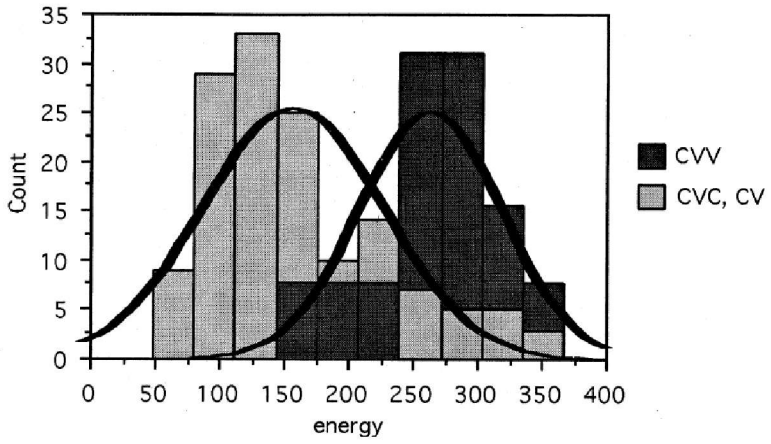
- Uncontroversial are the rhyme changes: lengthening of vowels, gemination of posttonic consonants.
- But also (Gordon): glottal stop insertion, which in some dialects of British English is only pretonic.

Kafka	[ˈkæfkə]		
Kafka is ...	[ˈkæfkəɹɪz...]		
Kafka election	[ˈkæfkəɹəˈlɛkʃən]	*Kafka elephants*	[ˈkæfkəˈʔɛləfənts]
Kafka-ish	[ˈkæfkəɹɪʃ]	*Kafkaesque*	[ˌkæfkəˈʔɛsk]

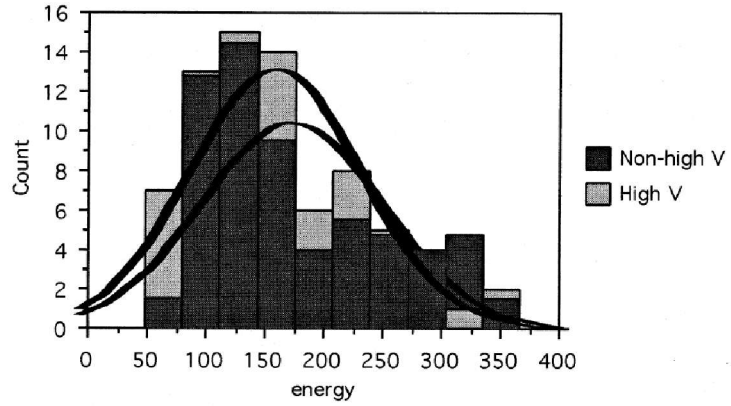
21. Can the weight criterion be predicted? Gordon's two criteria

- **Fit to map**
  - sample comparison:

Effective distinction (Khalkha energy: CVV > CVC, CV)



Ineffective distinction (Khalkha energy: Non-high V > High V)



  - He finds an appropriate statistic to assess this degree of fit

- **Simplicity**

  - Book, p. 134: "A weight distinction is complex iff: it refers to more than one place predicate OR it makes reference to disjoint representations of the syllable.

Table 4.2. Weight distinctions and their phonological dimensions

	Predicates	Dimension	
		Non-place	Place
CVV(C) heavy	$[X]_R$ $[X]_R$ | | +syllabic +syllabic	4	0
CVV(C), CVC heavy	$[X]_R$ $[X]_R$	2	0
CVV(C), CVR heavy	-const.gl. -const.gl. | | $[X]_R$ $[X]_R$ | | +sonorant +sonorant	6	0
CVVC, CVCC heavy	$[X]_R$ $[X]_R$ $[X]_R$	3	0
Non-high V heavy	-high | $[X]_R$ | +syllabic	2	1
Low V heavy	+low | $[X]_R$ | +syllabic	2	1

22. Allowed under the complexity criterion

- vowel height cutoffs, alone
- branching rhyme
- [+syllabic] segments
- has onset, no onset

23. Not allowed

- E.g., blend of the above: "Stress the leftmost long low vowel of the word."

24. Success

- The observed criteria do seem to single out what gets used; and both of them are needed.
- The theory has teeth: it is *committed* to some consistent relative patterns, which emerge from the map.
  - CVV is always heavier or equal to CVC.
  - CVC always heavier or equal to CV.

  - Onset-based distinctions will not trump rhyme ones.
  - Vowel height distinctions will not trump rhyme-length distinctions
  - No reversed vowel height distinctions.
- These implications have been extensively investigated since then by Kevin Ryan and seem to be holding up well.

25. Gordon's exterminationism with respect to moras, etc.

- Moras provide little explanatory payoff if they are not a parameter set by language.
  - Indeed, they fail to cover compensatory lengthening under onset loss, which exists; work of Kavitskaya, Loporcaro, Topintzi
- So Gordon is an exterminationist regarding syllable structure and segmental slots:
  - Segment slots are X's (one per "segment")
  - Vowels bear the good-old feature [+syllabic]
  - All the work goes into the constraint system, which refers to the structural properties relevant to weight.

26. Ryan advocates a bit of pendulum-swing

- See:
  - readings
  - His recent book (2019) *Prosodic weight: categories and continua*. Oxford UP.
- He thinks
  - moras can be rehabilitated
  - geminates can be defined by bearing a mora

GRADIENCE AND RYAN'S LAW

27. Gradient contexts

- Here, we look at some database:
  - a digital lexicon
  - a body of quantitative verse

  and examine it with statistical tools to find the gradient patterns.

28. Ryan's Law

- Where syllable weight is treated gradiently/statistically, *virtually all criteria get accessed*.
- The Gordonian primordial slime does not disappear once the categorical weight criterion is extracted!
  - Stochastic phonology and metrics still can "see" gradient phonetics.

29. Examples

- Kelly on English, above

- Probably, Nanni on *-ative*, above

THE PRIMARY TESTING GROUND FOR RYAN'S LAW: CLASSICAL METER

30. Main reference

- Kevin M. Ryan (2011) Gradient syllable weight and weight universals in quantitative metrics. *Phonology* 28:413–454. (readings)
- This is the journal-distillation of part of his UCLA dissertation:
  - *Gradient Weight in Phonology*, UCLA diss., 2011
- … and you can learn more by reading his recent book.

31. Some quantitative meters

- Greco-Latin dactylic hexameter

1		2		3		4		5		6
L	B	L	B	L	B	L	B	L	B	L
–	– ⏑	–	– ⏑	–	– ⏑	–	– ⏑	–	– ⏑	–	– ⏑

  - Some classicist terminology: L = "longum", B = "biceps"[1]

  - Example from the *Iliad* (Ryan 2011, discussed below)

a. τριπλῇ τετ|ραπ|λῇ τ᾽ ἀποτείσομεν, αἴ κέ ποθι Ζεὺς 1.128
trip.lɛ:j]$_1$ tet.|rap|]$_2$lɛ:j • t᾽ a.po]$_3$tej.so.me]$_4$n aj .ke .po]$_5$t^{h}i z.dews]$_6$
– –]$_1$ – |–|]$_2$ – • ⏑ ⏑]$_3$ – ⏑ ⏑]$_4$ – ⏑ ⏑]$_5$ – –]$_6$

b. εἴ ταρ ὅ γ᾽ εὐ|χω|λης ἐπιμέμφεται ἠδ᾽ ἐκατόμβης 1.065
ej .ta.r ^{h}o]$_1$ g᾽ ew.|k^{h}ɔ:|]$_2$lɛ: • s e.pi]$_3$mem.p^{h}e.ta]$_4$j ɛ:.d᾽
^{h}e.ka]$_5$tom.bɛ:s]$_6$
– ⏑ ⏑]$_1$ – |–|]$_2$ – • ⏑ ⏑]$_3$ – ⏑ ⏑]$_4$ – ⏑ ⏑]$_5$ – –]$_6$

- Persian meters (tradition flourished ca. 600-1900; best ref. is Elwell-Sutton 1976; analysis in Hayes 1979)

a. ⏑ — — — ⏑ — — — ⏑ — — — ⏑ — — —
b. — ⏑ — — — ⏑ — — — ⏑ — — — ⏑ —

[1] "Biceps" has a nice plural, *bicipitia*.

c. ⏑ – ⏑ – / $\left\{\begin{matrix}⏑\ ⏑\\ –\end{matrix}\right\}$ – – / ⏑ – ⏑ – / $\left\{\begin{matrix}⏑\ ⏑\\ –\end{matrix}\right\}$ –

d. — — ⏑ ⏑ — — ⏑ ⏑ — — ⏑ ⏑ —

e. — — ⏑ ⏑ — ⏑ —⏑ — — ⏑ ⏑ —[2]

- Hausa (Hayes and Schuh 2019, *Language*)

$\left\{\begin{matrix}⏑\ ⏑\\ —\end{matrix}\right\}$ — $\left\{\begin{matrix}⏑\ ⏑\\ —\end{matrix}\right\}$ — $\left\{\begin{matrix}⏑\ ⏑\\ —\end{matrix}\right\}$ — ⏑ —

(and many others)

32. Typology of quantitative verse

- Quantitative meter is a lot like stress-based meter in that it is usually
  - periodic (sequence of parallel constituents)
  - based on hierarchy — e.g. tetrameters are favored
  - prone to leaving out stuff at the end (catalexis)
  - It tends to require stricter adherence to the template at the end of the line.[3]

- Quantity is "swamped" by stress, and so quantitative meter is largely found in stress-free, or weak-stress languages.

- Yet stress languages can nevertheless use quantity in verse — typically, they regulate only (or principally) the quantity of stressed syllables.
  - Old Norse, discussed by Ryan
  - Finnish, discussed by Ryan
  - The English quantitative verse of Gerard Manley Hopkins (Kiparsky 1989; Hayes and Moore-Cantwell, *Phonology* 2011)

- Unlike stress-based meter, quantity is sometime deployed in quite baffling, aperiodic meters.
  - Greek lyric verse, also Sanskrit
  - Perhaps these anchored their irregular quantity patterns to a sung melody?

33. Ryan's Law in early literature

- Earlier students (traditional classics scholars, and even the ancients themselves) had a sense that Ryan's Law is applicable in certain cases.
- But they didn't have statistical testing to prove their point.

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[2] for Rubaiyat

[3] Exception: weight is virtually never enforced in *absolute* final position; perhaps not audible there?

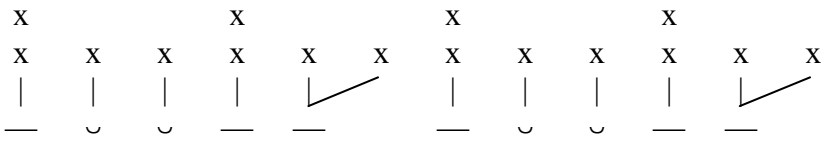
34. Longum vs. biceps in Homer

- Ryan downloaded and autoscanned the *Iliad* and *Odyssey*.
- He compared what *sort of* heavies occur in
  - longum (obligatory —) position
  - biceps (varies with ⏑ ⏑)
- Here is a simple result:

	VV rhyme	VC rhyme	VV : VC ratio
longum	75,931	58,862	1·290
biceps	19,143	8,946	2·140

35. Excursus: Why should *biceps* be the "stronger" position?

- Everyone always recited the dactylic hexameter as "DUM duh-duh DUM duh-duh DUM duh-duh DUM duh-duh DUM duh-duh DUM dum", right?
- This is not just an amateur intuition:
  - In a living tradition (work of Russ Schuh), Hausa musicians tend to sing heavy syllables on the strong beat.
- One option for Hausa singer/poets is to sing "longum" as a single *strong* beat, "biceps" as two weak beats:



  - Perhaps Homer sang thus? This would justify making the "weak" biceps longer than the "strong" longum.

36. A methodological factor that always plagues inferences about meter

- How do we factor out patterns, especially quantitative ones, that might be "inevitable", given the phonology and lexicon of the language?
- There arose a whole school of metrists, the "Russian school", that devoted thought to overcoming this difficulty.[4]

[4] See my "Milton, maxent, and the Russian method", on my web site, for a frustrating attempt to apply the Russian method, with counterintuitive results.

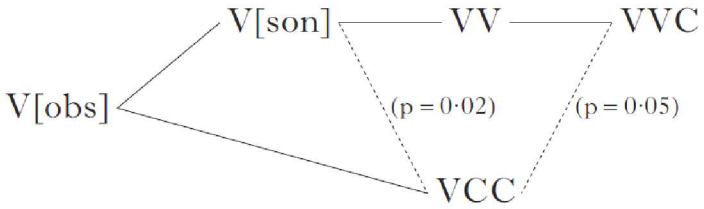
37. A very simple way to control in the case of Homer: just examine second syllables of words with the shape / — — /

	VV rhyme	VC rhyme	VV:VC ratio
longum	6,810	3,999	1·703
biceps	3,829	1,513	2·531

38. Doing it more carefully with modern statistics

- **Mixed-effects regression models** have fully taken over the world of statistical testing for experimental work, at least in linguistics.
  - You can factor out unwanted "noisy" effects from the behavior of individual subjects and test items — these are treated as **random effects**, whereas the general, meaningful things we are interested in are treated as **fixed effects**.
  - The testing returns not just a p-value, but a baby theory, much like maxent, of how the domain under study works.
  - See Ryan p. 419 for references covering these models.
- Jesse Zymet in his 2018 UCLA dissertation suggests we may be headed this way for ordinary phonology — phonological processes may be more sensitive to particular lexical items than we have previously thought; these are his random effect.
- Ryan applies the method to his Greek data: the random effect here is "word context".
  - e.g., "I am a syllable preceded by ⏑ and followed by one single — in my word"
- The payoff is rigorous statistical testing, which ends up justifying an **extensive hierarchy** of weight criteria, which is quite sensible from a Gordonian point of view:

Hasse diagram for five rhyme types

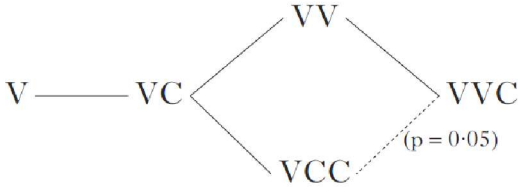


39. What about onsets?

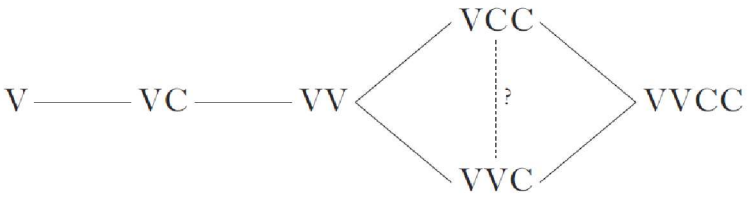
- These appear only in the dissertation, not the paper, but the result is the same:
  - with statistical significance, onset CC makes greater weight than onset C than onset null.

40. Other quantitative systems studied

Hasse diagram for Finnish rhyme skeletons



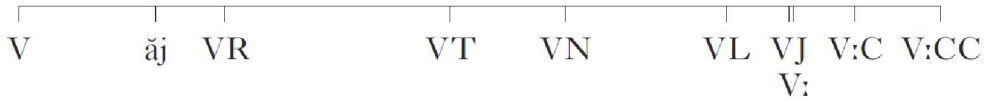
Hasse diagram for Old Norse rhyme skeletons



41. Tamil (poetry of Kamban, ca. 1200)

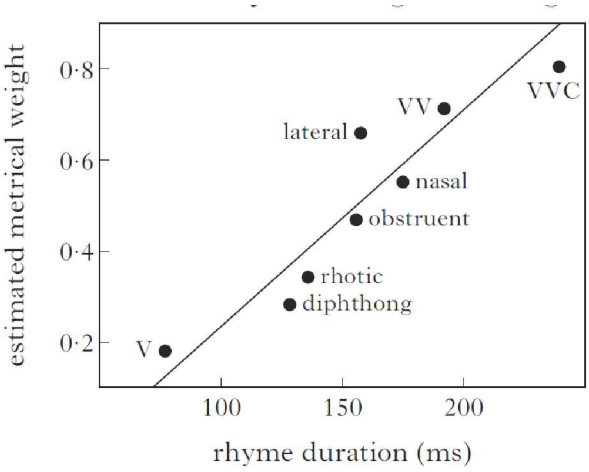
- This is by far the messiest, but nevertheless has a gradient orderliness:

Estimated weights of the rhyme types in Table IX



42. Tamil and phonetics

- Tamil is highly diglossic (acrolect, basilects).
- The acrolectal variety is phonologically very conservative.
- Amazingly, modern prestige speech, when measured by Ryan, provides syllable durations that match Kamban's scansions rather well.
- These rationalize the otherwise-baffling behavior of coda [j] and [r].


estimated metrical weight
0·8
0·6
0·4
0·2
VVC
VV
lateral
nasal
obstruent
rhotic
diphthong
V
100
150
200
rhyme duration (ms)