Finding rhythm in prose and poetry

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Which is prose, which is verse?

her pleasure in the walk must arise
from the exercise and the day,
from the view of the last smiles of the year
upon the tawny leaves, and withered hedges

to swell the gourd, and plump the hazel shells
with a sweet kernel; to set budding more,
and still more, later flowers for the bees,
until they think warm days will never cease

Which is prose, which is verse?

mankind do know of hell
fled away into the storm
the castle or the cot
her vespers done of all
a richness that the cloudy
fix'd as in poetic sleep
cold fair isabel poor simple
little cottage i have found
last prayer if one of
one hour half-idiot he stands

readiness to measure time by
in a trio while i
your sisters severally to george
the weather is unfavourable for
be in time perhaps it
i shall horribly commit myself
as bad again just now
i shall have got some
bless you sunday evening my
bars at charles the first

How do we tell prose from verse?

Typography (long lines, short lines, indentation)

Topic

Vocabulary (*your sisters severally to George*)

Rhythm (rhyme, alliteration, assonance, parallelism, **meter**,…)

Do prose and verse have different phonology?

Authors: Five English and five Finnish authors who wrote both prose and verse (https://www.gutenberg.org/):

- Keats, Shelley, Whitman, Wordsworth, Yeats (English)
- Erkko, Kaatra, Leino, Lönnrot, Siljo (Finnish)

Data: 500 randomly sampled five-word “lines” for each author-genre pair, about 10,000 lines in all

Scansion

Meter is about a correspondence between metrical positions (strong, weak) and their phonological realization (see, e.g., Kiparsky 1977, Prince 1989, Hayes, Wilson and Shisko 2012, Blumenfeld 2015).

The cúrfew tólls the knéll of párting dáy

This correspondence is also called SCANSION.

Iambic pentameter

w s w s w s w s w s

I cán't belíeve that I forgót my kéys

	s	w
+ stress	4	0
– stress	1	5

w s w s w s w s w s

I cán't belíeve that Ánn forgót her kéys

	s	w
+ stress	5	0
– stress	0	5

Iambic pentameter

	s	w
+ stress	4	0
– stress	1	5

	s	w
+ stress	1	4
– stress	4	1

Iambic tetrameter (Finnish, V. A. Koskenniemi)

w s w s w s w s		s	w
Ei sú.vi ól.lut, jú.han.nùs,	+ stress	4	0
	– stress	0	4

w s w s w s w s		s	w
kun sýn.nyit, Súo.men vá.pa.ùs,	+ stress	4	0
	– stress	0	4

‘No summer was, midsummer, when you were born, Finland Freedom’ (Google translate)

The general principles

Stress-based meters:

- A stressed syllable cannot occur in a weak position
- An unstressed syllable cannot occur in a strong position

Length-based meters:

- A long syllable cannot occur in a weak position
- An short syllable cannot occur in a strong position

The Kalevala meter (Leino 2002, p. 161):

s	w	s	w	s	w	s	w	//	s	w	s	w	s	w	s	w
Már.jat.ta,		kó.re.a		kúo.pus				//	se	káu.an		kó.to.na		kás.voi		
s	w	s	w	s	w	s	w	//	s	w	s	w	s	w	s	w
kór.ke.an		í.son		kó.to.na				//	é.mon	tút.ta.van		tú.vil.la				

’Marjatta, who is the youngest Korean, it grew long at home, high big at home, mother's acquaintance huts.’ (Google translate)

- A long stressed syllable cannot occur in a weak position
- A short stressed syllable cannot occur in a strong position.
- Both principles can be violated in the line-initial foot.

Metrical constraints

Mainstream English and Finnish meters pay attention to different constraints (Hanson and Kiparsky 1996 = H&K, pp. 287-8):

- Shakespeare's iambic pentameter:

  *W/PEAK ‘w may not contain a peak’

- Finnish iambic-anapestic (trochaic-dactylic) meters:

  *S/UNSTRESSED ‘s may not contain an unstressed syllable’

The constraint *W/PEAK

A PEAK is the main stress of a polysyllable:

mány, réptìle (peak + trough)

imménse, màintáin (trough + peak)

kéen (neither)

*W/PEAK violations

*W/PEAK violations

w s w s w s w s w s

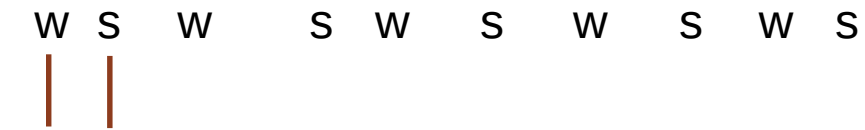
1

Néver cáme póison fróm só swéet a pláce

(*Richard III.1.2*)

*W/PEAK violations

*W/PEAK violations



1

(*Richard III.1.2*)

2

(*construct*)

Phonological constraints

PEAKPROMINENCE	'No stressed short syllables'
WEIGHT-TO-STRESS	'No unstressed long syllables'
NOCLASH	'No adjacent stressed syllables'
NOLAPSE	'No adjacent unstressed syllables'

short syllable: CV

long syllable: CVV, CVC, CVVC, CVCC

(see, e.g., Prince 1990, Prince and Smolensky 1993/2004)

Questions

Do prose and verse differ objectively in terms of these constraints?

1. Based on H&K 1996, we would expect
   - English verse to violate *W/PEAK less than English prose
     (How about Finnish verse/prose?)
   - Finnish verse to violate *S/UNSTRESSED less than Finnish prose
     (How about English verse/prose?)

2. Should we expect PEAKPROMINENCE, WEIGHT-TO-STRESS, NOCLASH, and NOLAPSE to be violated less in verse than in prose?

Maybe we should…

“I wish our clever young poets would remember my homely definitions of prose and poetry; that is, prose = words in their best order; poetry = the best words in their best order.”

Samuel Taylor Coleridge, 12 July 1827

https://en.wikiquote.org/wiki/Samuel_Taylor_Coleridge

Method

- We need phonologically and metrically annotated corpora.

- We used PROSODIC (Heuser, Falk, and Anttila 2010-2011), phonological analysis and metrical scansion software developed at Stanford, available at https://github.com/quadrismegistus/prosodic

Prosodic

Input:

- Metrical constraints parametrized by the user
- Plain text (from keyboard or text file)

Output:

- Phonologically annotated text (stress, weight, syllabification, etc.)
- All the possible metrical scansions
- For each scansion, violation count for each constraint

Phonological annotation

English from the CMU Dictionary (Weide 1998) and OpenMary (http://mary.dfki.de/); Finnish syllabifier written by Josh Falk.

i	P:'aÉª	S:P	W:H
shall	P:'ÊƒÃ¦l	S:P	W:H
horribly	P:'hÉ”Ë□.rÉ™.bliË□	S:PUU	W:HLH
commit	P:kÉ™.'mÉªt	S:UP	W:LH
myself	P:`maÉª.'sÉ›lf	S:SP	W:HH
kellon	P:'kel.lon	S:PU	W:HH
avutonta	P:'a.vu.`ton.ta	S:PUSU	W:LLHL
ontuvaa	P:'on.tu.vaa	S:PUU	W:HLH
naksutusta	P:'nak.su.`tus.ta	S:PUSU	W:HLHL
ei	P:'ei	S:P	W:H

Metrical scansion

For 10-syllable line the upper bound is 2^{10} = 1,024 candidate scansions. PROSODIC takes the following steps:

- assign each scansion a constraint violation vector
- discard harmonically bounded scansions

  (for harmonic bounding, see, e.g., McCarthy 2008:80-83)
- return the remaining scansions with violations for each constraint

Stress ambiguities are resolved by scansion, e.g., *a* = [ə] vs. *á* = [eɪ]; *in* vs. *ín*, etc.

Four metrical constraints (we've seen two above)

*W/STRESSED	No stressed syllable in a weak position.
*S/UNSTRESSED	No unstressed syllable in a strong position.
*W/PEAK	No peak in a weak position.
*S/TROUGH	No trough in a strong position.

Initial assumptions (to be revised later):

- position size = syllable
- only one syllable per position

Never came poison from so sweet a place

Only the iambic scansion is possible.

[parse #1 of 1]: 5 errors

1	w	ne	***W/PEAK**, *W/STRESSED
2	s	VER	*S/UNSTRESSED, *S/TROUGH
3	w	came	*W/STRESSED
4	s	POI	
5	w	son	
6	s	FROM	
7	w	so	
8	s	SWEET	
9	w	a	
10	s	PLACE	

Never had rat-poison so sweet a taste

The trochaic scansion is optimal. Note how PROSODIC selects *á* = [eɪ].

[parse #1 of 2]: 5 errors

1	s	NE	
2	w	ver	
3	s	HAD	*S/UNSTRESSED
4	w	rat	*W/STRESSED
5	s	POI	
6	w	son	
7	s	SO	*S/UNSTRESSED
8	w	sweet	*W/STRESSED
9	s	A	
10	w	taste	*W/STRESSED

Never had rat-poison so sweet a taste

The iambic scansion is also predicted to be possible, but worse.

[parse #2 of 2]: 8 errors

1	w	ne	*W/STRESSED, ***W/PEAK**
2	s	VER	*S/TROUGH, *S/UNSTRESSED
3	w	had	
4	s	RAT	
5	w	poi	*W/STRESSED, ***W/PEAK**
6	s	SON	*S/TROUGH, *S/UNSTRESSED
7	w	so	
8	s	SWEET	
9	w	a	
10	s	TASTE	

To be or not to be that is the question

Only the iambic scansion is possible.

[parse #1 of 1]: 3 errors

1	w	to	
2	s	BE	*S/UNSTRESSED
3	w	or	
4	s	NOT	
5	w	to	
6	s	BE	*S/UNSTRESSED
7	w	that	
8	s	IS	*S/UNSTRESSED
9	w	the	
10	s	QUE	
11	w	stion	

Relaxing the meter

Relaxing the meter by allowing weak positions up to two syllables (= resolution) we get the dactylic scansion (Blumenfeld 2015, 84).

[parse #1 of 2]: 1 errors

1	s	TO	*S/UNSTRESSED
2	w	be or	
3	s	NOT	
4	w	to be	
5	s	THAT	
6	w	is the	
7	s	QUE	
8	w	stion	

How about prose scansion?

The great advantage of PROSODIC is that it blindly analyses any text, metered verse as well as unmetered prose.

The key point:

The resulting constraint violation profiles yield rich information about differences among texts.

The only thing we have to fear is fear itself

From the FDR inaugural address. No violations.

1	w	the
2	s	ONL
3	w	y
4	s	THING
5	w	we
6	s	HAVE
7	w	to
8	s	FEAR
9	w	is
10	s	FEAR
11	w	its
12	s	ELF

Fear itself is the only thing we have to fear

This is a construct.

1	w	fear	*W/STRESSED
2	s	ITS	*S/TROUGH, *S/UNSTRESSED
3	w	elf	*W/STRESSED, ***W/PEAK**
4	s	IS	*S/UNSTRESSED
5	w	the	
6	s	ONL	
7	w	y	
8	s	THING	
9	w	we	
10	s	HAVE	
11	w	to	
12	s	FEAR	

Our experiment

The goals:

- Use PROSODIC to listen to differences between prose and verse.
- Put H&K's claim about English and Finnish meters to empirical test.

Background

In our data, each line has five words with no punctuation.

Therefore, any difference between prose and verse can only depend on the choice and arrangement of words, not on line length.

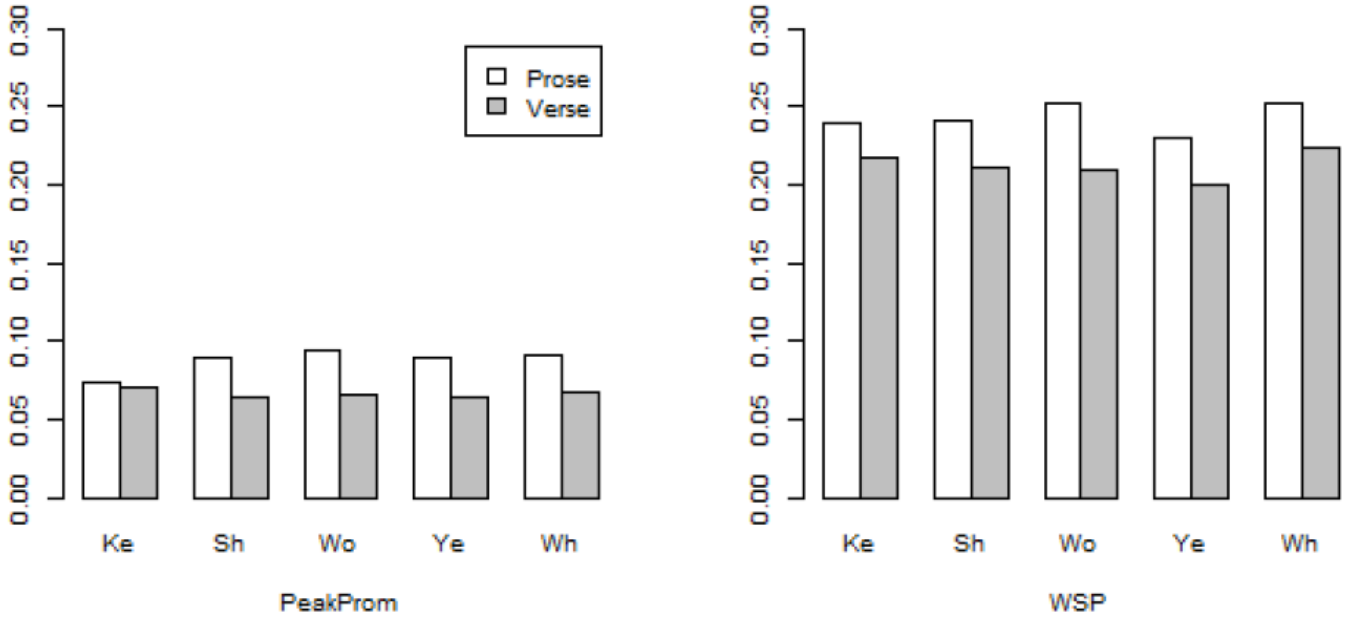
Metrical parameter setting:

s = one syllable

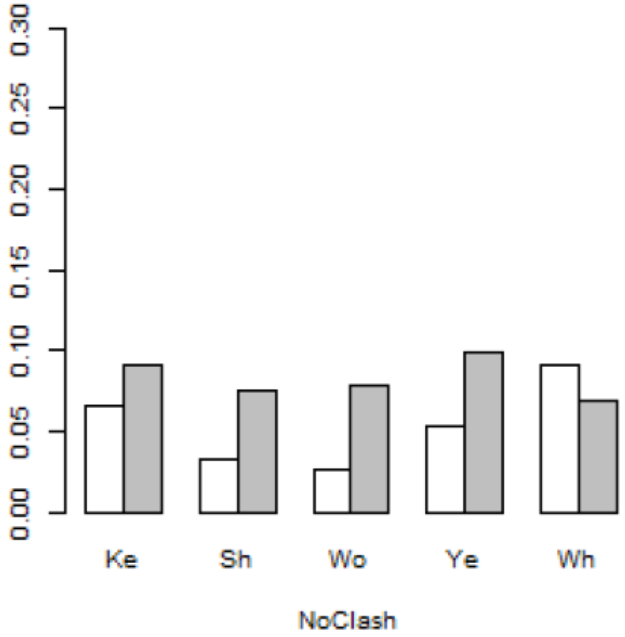
w = one or two syllables

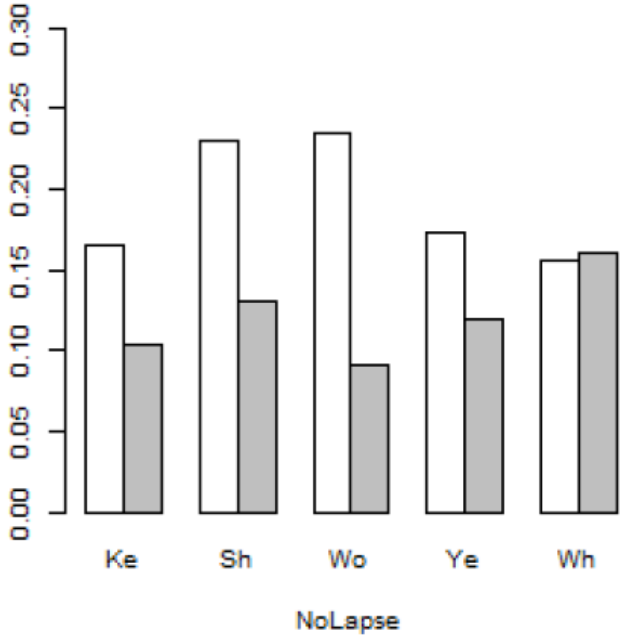
Violation counts were normalized by dividing the sum of violations by the number of scansions and the number of syllables in the line.

English: Mean violation scores (phonology)



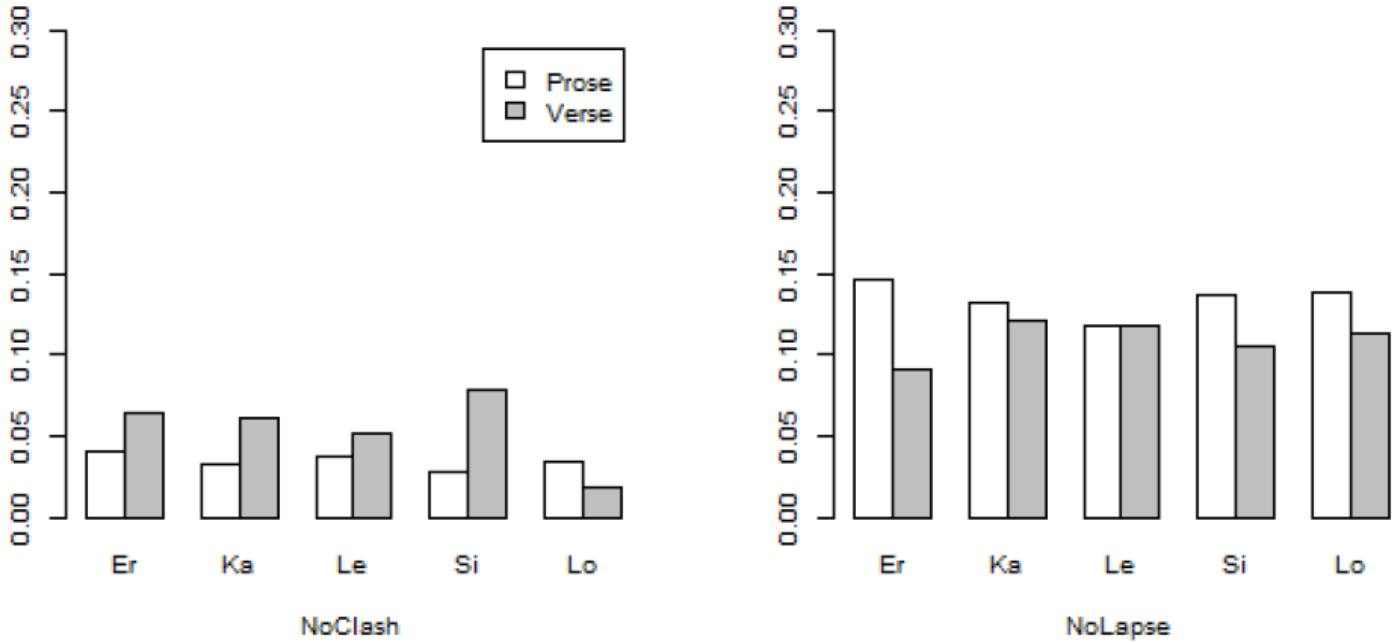
English: Mean violation scores (phonology)





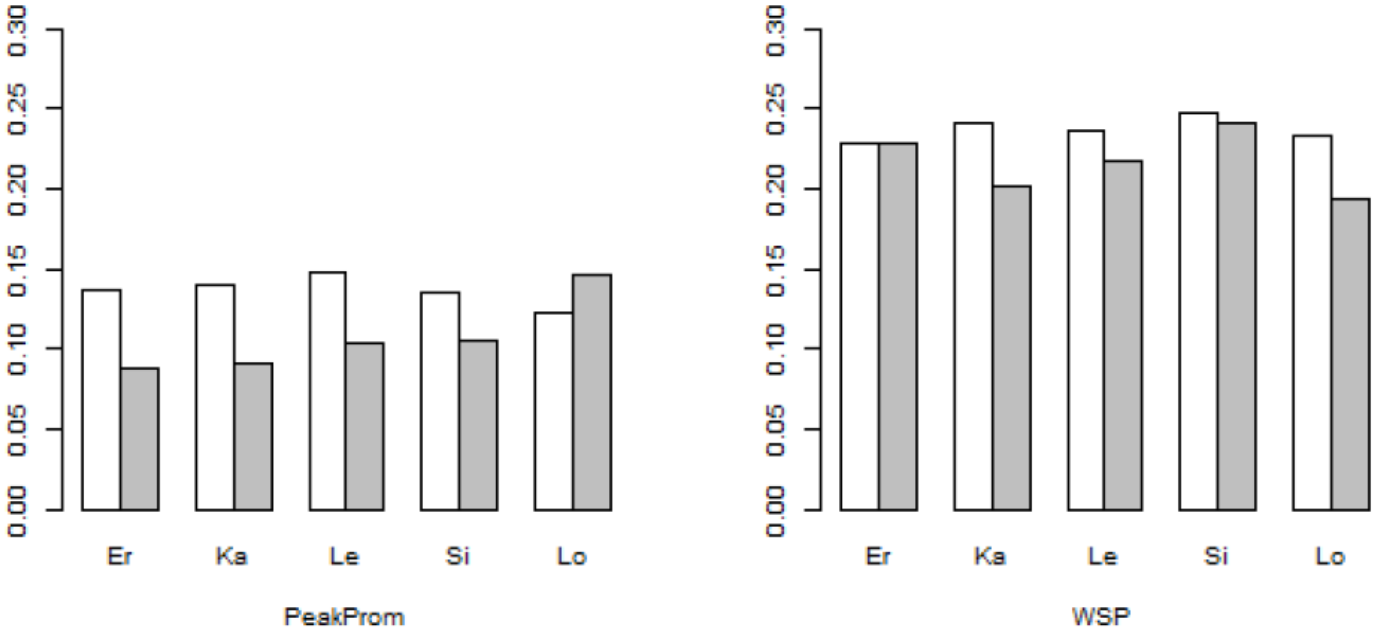
Whitman is different (NoClash, NoLapse). Free verse scans like prose?

Finnish: Mean violation scores (phonology)



Lönnrot seems different (NoClash). Why?

Finnish: Mean violation scores (phonology)



Lönnrot is again different (PEAKPROM). Is this because of Kalevala meter?

Taking a closer look at the data

- For metrical constraints, raw mean violations are not helpful.
- In order to understand the data better we modeled it using LOGISTIC REGRESSION (see, e.g., Baayen 2008, Dalgaard 2008).
- The advantage of logistic regression is that it allows us to consider several predictors at once.

Mixed-effects logistic regression (Bates et al. 2014)

- Dependent variable: prose vs. verse
- Predictors: constraint violations, normalized and centered
- Random variable: author

- Only 6 constraints (4 phonological, 2 metrical) were included in the final model.

Summary of results

Which constraint violations predict which genre?

		English	Finnish
Phonology:	PeakProm	prose	prose
	WSP	prose	prose
	NoLapse	prose	prose
	NoClash	verse	verse
Metrics:	*w/peak	prose	(non-sig.)
	*s/unstressed	verse	prose

Model summary (English)

Positive estimate means the predictor favors prose.

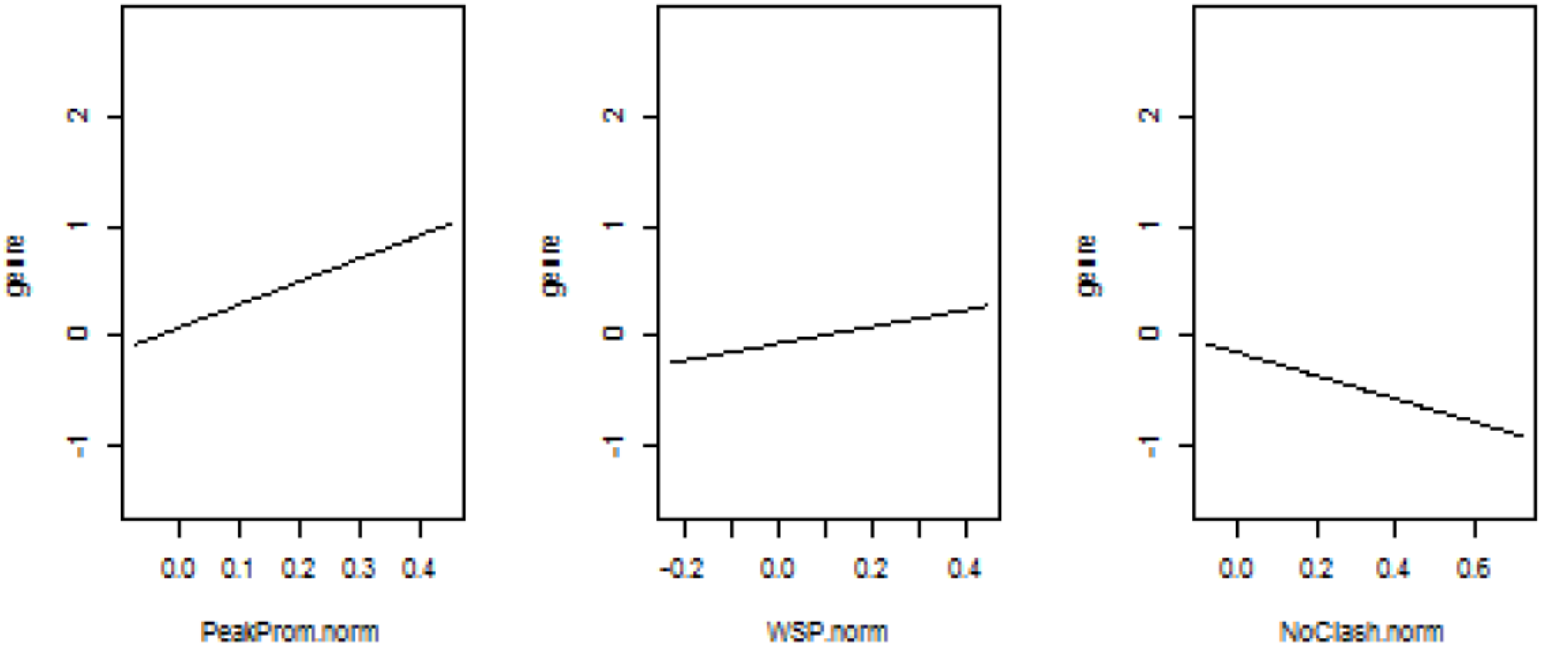
```
ENGLISH
Random effects:
 Groups Name        Variance Std.Dev.
 author (Intercept) 0.001642 0.04053
Number of obs: 4998, groups: author, 5

Fixed effects:
                     Estimate Std. Error z value Pr(>|z|)
(Intercept)          -0.09753    0.03524  -2.767 0.005653 **
PeakProm.norm         2.08197    0.34404   6.051 1.44e-09 ***
WSP.norm              0.76773    0.24316   3.157 0.001592 **
NoClash.norm         -1.04891    0.29099  -3.605 0.000313 ***
NoLapse.norm          5.51222    0.34636  15.915  < 2e-16 ***
strength.w.not.p.norm 3.89676    1.02916   3.786 0.000153 ***
stress.s.not.u.norm  -4.99254    0.81942  -6.093 1.11e-09 ***
---
```

Model summary (Finnish)

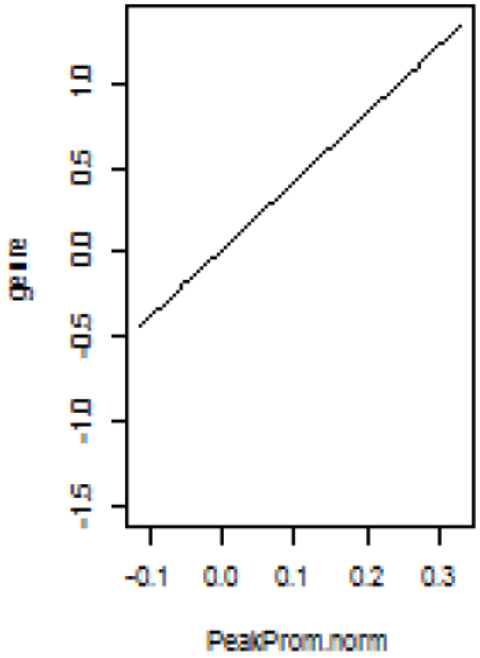
Positive estimate means the predictor favors prose.

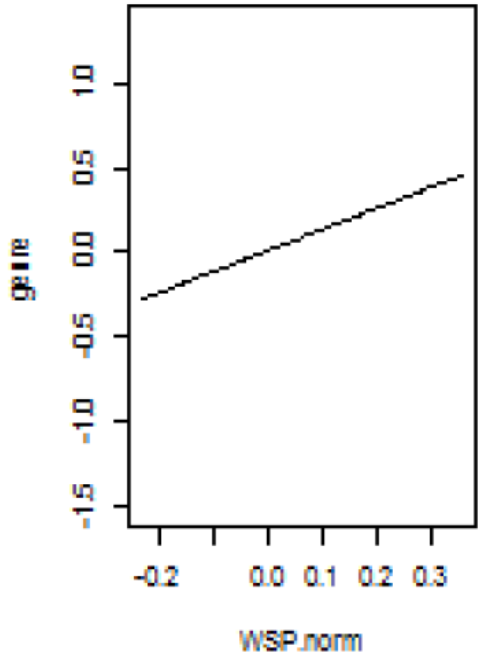
```
FINNISH
Random effects:
 Groups Name        Variance Std.Dev.
 author (Intercept) 0        0
Number of obs: 5000, groups: author, 5

Fixed effects:
                     Estimate Std. Error z value Pr(>|z|)
(Intercept)          -0.06681    0.02976  -2.245   0.0248 *
PeakProm.norm         3.97300    0.34936  11.372  < 2e-16 ***
WSP.norm              1.25149    0.28942   4.324 1.53e-05 ***
NoClash.norm         -2.27557    0.44093  -5.161 2.46e-07 ***
NoLapse.norm          3.00841    0.39749   7.568 3.78e-14 ***
strength.w.not.p.norm -5.35819    3.33638  -1.606   0.1083
stress.s.not.u.norm    3.86222    1.52721   2.529   0.0114 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

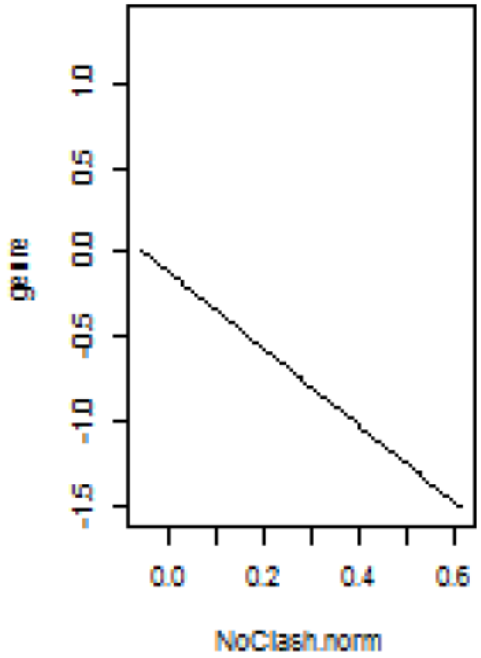
English: PeakProm, Weight-To-Stress, No Clash



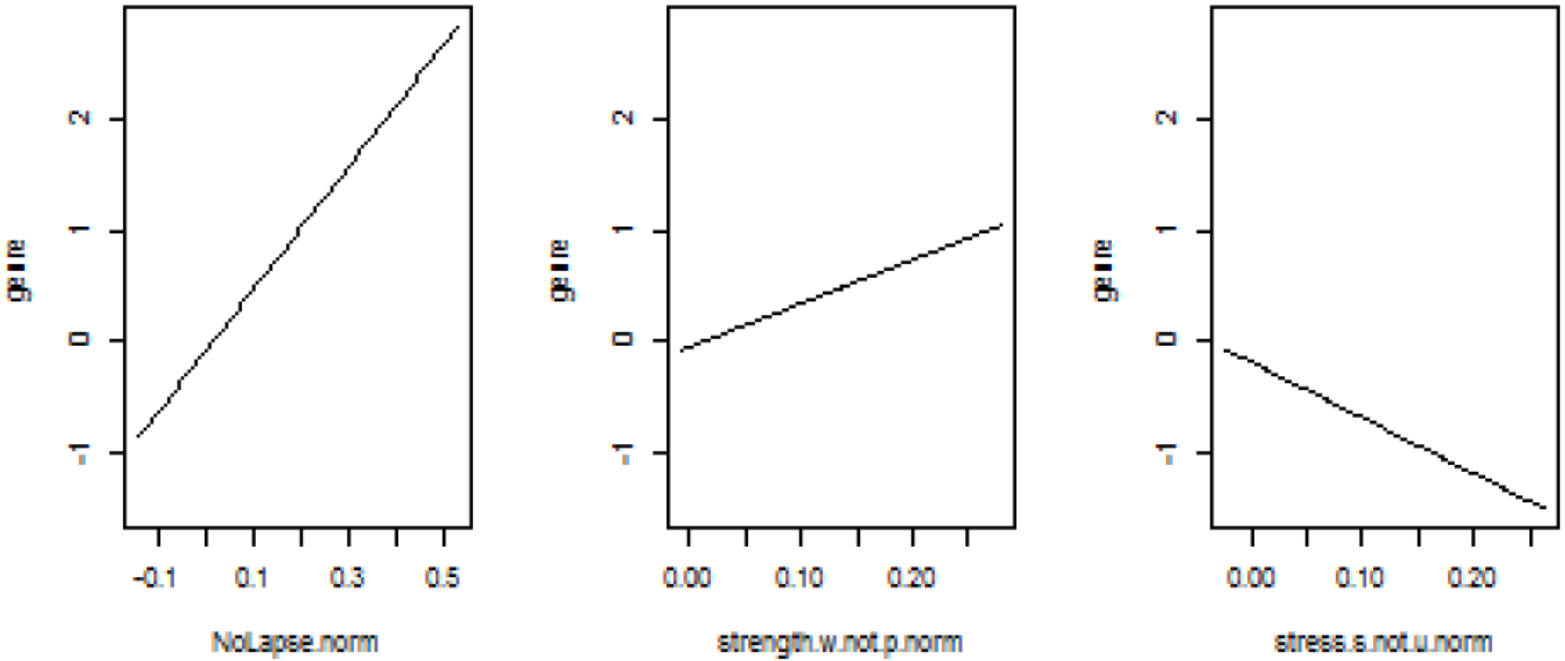
Finnish: PeakProm, Weight-To-Stress, No Clash



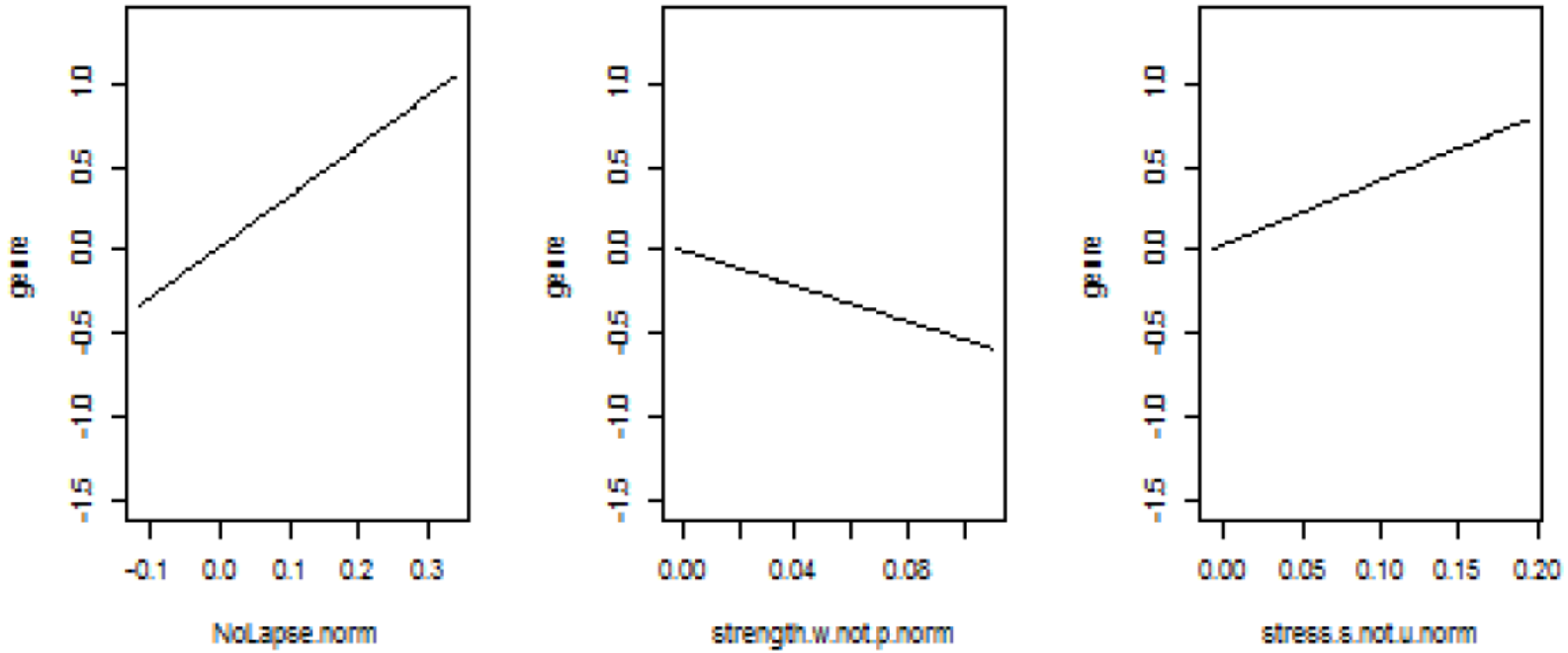




English: NO LAPSE, *W/PEAK, *S/UNSTRESSED



Finnish: NO LAPSE, *W/PEAK, *S/UNSTRESSED



Conclusions

Phonology

English and Finnish show the same differences between prose and verse:

- stress lapses are characteristic of prose
- stress clashes are characteristic of verse

Metrics

English verse avoids peaks in weak positions (H&K 1996), hence violations of *W/PEAK are highly predictive of prose ($p = 0.001$).

Finnish verse avoids unstressed syllables in strong positions (H&K 1996), hence violations of *S/UNSTRESSED are predictive of prose ($p = 0.05$).

Conclusions

Constraint violations depend on two things:

- PEAKPROM and WSP depend on word choice (up to lexical ambiguity).
- NOCLASH and NOLAPSE depend in addition on word linearization.

→ Prose and verse differ in the choice and linearization of words.

Questions for future work

- Are there differences across prose types?

> "You campaign in poetry. You govern in prose."
>
> Mario Cuomo, *The New Republic*, 4 April 1985,
> https://en.wikiquote.org/wiki/Mario_Cuomo

- Which phonological properties are invariant across styles, genres, etc.

- Which phonological properties vary?

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Open problem 1: English function word stress

(i) Words considered unstressed in the sample (*n* = 48):

ah, am, an, and, are, be, been, bout, can, could, had, has, hast, hath, he, her, him, his, if, i'll, is, it, its, lest, may, my, of, or, she, should, so, the, their, them, there's, they, thine, though, to, us, was, we, were, while, would, yore, you, your

(ii) Words considered stress-ambiguous in the sample (*n* = 119):

a, ad, age, all, art, as, at, back, but, by, can't, dare, de, di, did, die, do, does, done, don't, dost, down, each, few, for, force, from, grand, have, he'll, here, here's, how, i, i'd, in, i've, la, last, least, less, like, me, might, mine, mode, more, most, much, must, near, need, next, nor, o, off, on, one, one's, ought, out, pains, per, piece, place, pour, round, route, rue, sake, sang, save, say, shall, since, sit, sole, some, son, such, than, that, that's, thee, theirs, then, there, these, they'd, this, those, thou, through, thy, till, tout, up, we'll, we're, what, what's, when, whence, where, which, who, whom, whose, why, wil, will, wilt, with, ye, yet, you'd, you'll, you're, yours

Open problem 2: English syllable weight

(i) (Unambiguously) closed syllables are heavy.

(ii) Open syllable weight depends on the vowel:

- tense vowels count as heavy
- lax vowels count as light

Problems:

CITY S IH1 T IY0 /# [S '1 IH] [T '0 IY] #/ S:PU W:LH
CITY S IH1 T IY0 /# [S '1 IH T] ['0 IY] #/ S:PU W:HH
CITY S IH1 T IY0 /# [S '1 IH [T] '0 IY] #/ S:PU W:AH

Open problem 3: Syllabifying Finnish diphthongs

Several vowel pairs allow variable syllabification (vowel sequence vs. diphthong) depending on stress (Anttila and Shapiro, in progress):

/au/, /eu/, /ou/, /iu/, /iy/, /ey/, /äy/, /öy/

Consider /au/:

vá.pa.us ~ va.paus	‘freedom’
rák.ka.us ~ rak.kaus	‘love’
láu.ka.us ~ láu.kaus	‘shot’
(**lá.u.ka.us, *lá.u.kaus*)	