Phonological and metrical variation across genres

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1. The question

(1) Which is prose, which is verse?

mankind do know of hell                 readiness to measure time by
fled away into the storm               in a trio while i
the castle or the cot                 your sisters severally to george
her vespers done of all               the weather is unfavourable for
a richness that the cloudy           be in time perhaps it
fix’d as in poetic sleep              i shall horribly commit myself
cold fair isabel poor simple          as bad again just now
little cottage i have found           i shall have got some
last prayer if one of                 bless you sunday evening my
one hour half-idiot he stands         bars at charles the first

(2) Can we identify a line as prose vs. verse from its phonology and meter?

(3) Assume strict iambic pentameter where position = syllable:

(a) I can’t believe that I forgot my keys
(b) It rains almost always when I visit (Steele 1999)

<table>
<thead>
<tr>
<th>W</th>
<th>S</th>
<th>W</th>
<th>S</th>
<th>W</th>
<th>S</th>
<th>W</th>
<th>S</th>
<th>W</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>cá</td>
<td>n’t</td>
<td>bél</td>
<td>íve</td>
<td>th</td>
<td>at</td>
<td>I</td>
<td>fórg</td>
<td>ót</td>
</tr>
<tr>
<td>It</td>
<td>ráins</td>
<td>álmost</td>
<td>álways</td>
<td>whén</td>
<td>I</td>
<td>vísit</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| + stress | 4 | 0 | 1 | 4 | 1 |
|− stress  | 1 | 5 | 4 | 1 |


(5) Data: Five English and five Finnish authors (https://www.gutenberg.org/):

(a) Keats, Shelley, Whitman, Wordsworth, Yeats (both prose and verse)
(b) Erkko, Kaatra, Leino, Lõnnrot, Siljo (both prose and verse)

(6) Data: 500 randomly sampled lines for each author-genre pair, about 10,000 lines.
2. Constraints

(7) Phonological constraints (see, e.g., Prince 1990, Prince and Smolensky 1993/2004):
(a) PEAKPROM ‘No stressed lights (= Peak Prominence)’
(b) WSP ‘No unstressed heavies (= The Weight-to-Stress Principle)’
(c) NOCLASH ‘No adjacent stressed syllables’
(d) NOLAPSE ‘No adjacent unstressed syllables’

(8) Metrical correspondence constraints govern
(a) position size (mora vs. syllable vs. foot vs. word)
(b) prominence site (s vs. w),
(c) prominence type (stressed/unstressed vs. peak/trough vs. heavy/light)

(9) The key metrical constraints (Hanson and Kiparsky 1996 = H&K):
(a) *S/UNSTRESSED ‘A strong position may not contain an unstressed syllable’
(b) *W/PEAK ‘A weak position may not contain a peak’

(10) A PEAK is the head of a branching constituent (≈ the main stress in a polysyllable):
mány, réptile (peak + trough); imménsé, mánntáin (trough + peak); kéen (neither).

(11) *W/PEAK violations

\[ \text{Néver cáme póison fróm só swéét a pláce} \quad 1 \quad (Richard\ III.1.2) \]

\[ \text{Néver had ráti póison só swéét a táste} \quad 2 \quad \text{(construct)} \]

(12) Mainstream English and Finnish meters differ as follows (H&K, pp. 287-8):
(a) Shakespeare’s iambic pentameter cares about *W/PEAK.
(b) Finnish iambic-anapaestic (trochaic-dactylic) meters care about *S/UNSTRESSED.

3. Method

(13) We annotated the text with Prosodic (Heuser, Falk, and Anttila 2010-2011). For a combination of automatic and manual methods, see Hayes, Wilson and Shisko 2012.

(14) Input:
(a) Metrical constraints parametrized by the user
(b) Plain text (from keyboard or text file)

(15) Output:
(a) Phonologically annotated text (stress, weight, syllabification, etc.)
(b) All the possible metrical scansions
(c) For each scansion, violation count for each constraint
(16) **Phonological annotation**: English from the CMU Dictionary (Weide 1998) and OpenMary (http://mary.dfki.de/), Finnish from a Prosodic module written by Josh Falk.

\[
\begin{align*}
i & \quad P: 'a\mathbf{E}^* \\
\text{shall} & \quad P: '\mathbf{E}f\mathbf{A}^*l \\
\text{horribly} & \quad P: 'h\mathbf{E}''\mathbf{E}\mathbf{H}.r\mathbf{E}^*m.\mathbf{bli}\mathbf{E}^* \\
\text{commit} & \quad P: k\mathbf{E}''.'m\mathbf{E}^*'t \\
\text{myself} & \quad P: 'm\mathbf{a}\mathbf{E}^*.'s\mathbf{E}^*l \mathbf{f} \\
\text{kellon} & \quad P: 'k\mathbf{e}\mathbf{l}.\mathbf{l}o\mathbf{n} \\
\text{avutonta} & \quad P: 'a.vu.'\mathbf{t}o\mathbf{n}.t\mathbf{a} \\
\text{ontuva} & \quad P: 'o.n.tu.v\mathbf{a}a \\
\text{naksutusta} & \quad P: 'nak.su.'\mathbf{t}u\mathbf{s}.t\mathbf{a} \\
\text{ei} & \quad P: 'e\mathbf{i} \\
\end{align*}
\]

(17) **Metrical scansion**: Prosodic starts from all possible s/w scansion (for a line of 10 syllables the upper bound is \(2^{10} = 1,024\) scansion) and takes the following steps:
(a) assigns each scansion a constraint violation vector
(b) discards harmonically bounded scansion (see, e.g., McCarthy 2008:80-83)
(c) returns the remaining scansions with violations for each constraint

(18) Stress ambiguities are resolved by scansion, e.g., \(a = [\mathbf{o}]\) vs. \(\dot{a} = [\mathbf{e}t]\); \(in\) vs. \(\dot{in}\), etc.

(19) Since Prosodic blindly analyses any text, verse or prose, the resulting constraint violation profiles yield rich information about differences among texts.

4. Examples

(20) We are in transition between two constraint notations:

\[
\begin{align*}
\text{H&K 1996} & \quad \text{A&H 2015} & \quad \text{INTERPRETATION} \\
\text{(a)} & \quad \text{stress.s} \Rightarrow -u & \quad ^*S/\text{UNSTRESSED} & \quad \text{No unstroked syllables in S.} \\
\text{(b)} & \quad \text{stress.w} \Rightarrow -p & \quad ^*W/\text{STRESSED} & \quad \text{No stressed syllables in W.} \\
\text{(c)} & \quad \text{strength.s} \Rightarrow -u & \quad ^*S/\text{TROUGH} & \quad \text{No weak syllables (troughs) in S.} \\
\text{(d)} & \quad \text{strength.w} \Rightarrow -p & \quad ^*W/\text{PEAK} & \quad \text{No strong syllables (peaks) in W.} \\
\end{align*}
\]

4.1 Verse

(21) We start by assuming position size = syllable and no resolution.
(22) *Never came poison from so sweet a place. Only the iambic scansion is possible.*

<table>
<thead>
<tr>
<th>parse #1 of 1: 5 errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 w ne [*strength.w=-p][*stress.w=-p]</td>
</tr>
<tr>
<td>2 s VER [*stress.s=-u][*strength.s=-u]</td>
</tr>
<tr>
<td>3 w came [*stress.w=-p]</td>
</tr>
<tr>
<td>4 s POI</td>
</tr>
<tr>
<td>5 w son</td>
</tr>
<tr>
<td>6 s FROM</td>
</tr>
<tr>
<td>7 w so</td>
</tr>
<tr>
<td>8 s SWEET</td>
</tr>
<tr>
<td>9 w a</td>
</tr>
<tr>
<td>10 s PLACE</td>
</tr>
</tbody>
</table>

(23) *Never had rat-poison so sweet a taste. The trochaic scansion has fewer violations, but both are possible. Note that Prosodic smartly selects the stressed *á* = [eɪ].*

<table>
<thead>
<tr>
<th>parse #1 of 2: 5 errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 s NE</td>
</tr>
<tr>
<td>2 w ver</td>
</tr>
<tr>
<td>3 s HAD [*stress.s=-u]</td>
</tr>
<tr>
<td>4 w rat [*stress.w=-p]</td>
</tr>
<tr>
<td>5 s POI</td>
</tr>
<tr>
<td>6 w son</td>
</tr>
<tr>
<td>7 s SO [*stress.s=-u]</td>
</tr>
<tr>
<td>8 w sweet [*stress.w=-p]</td>
</tr>
<tr>
<td>9 s A</td>
</tr>
<tr>
<td>10 w taste</td>
</tr>
</tbody>
</table>

(24) *To be or not to be that is the question. Only iambic scansion is possible.*

<table>
<thead>
<tr>
<th>parse #1 of 1: 3 errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 w to</td>
</tr>
<tr>
<td>2 s BE [*stress.s=-u]</td>
</tr>
<tr>
<td>3 w or</td>
</tr>
<tr>
<td>4 s NOT</td>
</tr>
<tr>
<td>5 w to</td>
</tr>
<tr>
<td>6 s BE [*stress.s=-u]</td>
</tr>
<tr>
<td>7 w that</td>
</tr>
<tr>
<td>8 s IS [*stress.s=-u]</td>
</tr>
<tr>
<td>9 w the</td>
</tr>
<tr>
<td>10 s QUE</td>
</tr>
<tr>
<td>11 w stion</td>
</tr>
</tbody>
</table>

(25) Relaxing the metrical parameters yields more scansion. Allowing weak positions to have up to two syllables gets us the dactylic scansion (Blumenfeld 2015, 84):

<table>
<thead>
<tr>
<th>parse #1 of 2: 1 errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 s TO [*stress.s=-u]</td>
</tr>
<tr>
<td>2 w be or</td>
</tr>
<tr>
<td>3 s NOT</td>
</tr>
<tr>
<td>4 w to be</td>
</tr>
<tr>
<td>5 s THAT</td>
</tr>
<tr>
<td>6 w is the</td>
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<tr>
<td>7 s QUE</td>
</tr>
<tr>
<td>8 w stion</td>
</tr>
</tbody>
</table>
4.2 Prose (baseline)

(26)  *The only thing we have to fear is fear itself* (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

(27)  *Fear itself is the only thing we have to fear* (construct)

1. w       fear       [*stress.w=>-p]
2. s       ITS       [*strength.s=>-u][*stress.s=>-u]
3. w       elf       [*stress.w=>-p][*strength.w=>-p]
4. s       IS       [*stress.s=>-u]
5. w       the
6. s       ONL
7. w       y
8. s       THING
9. w       we
10. s      HAVE
11. w      to
12. s      FEAR

(28)  Prose is metrically more ambiguous than verse and tends to allow more scansion.

5. Our experiment

(29)  Goals:
(a)  To explore phonological and metrical differences between prose and verse
(b)  To test H&K’s claim about the difference between English and Finnish meters
(c)  Find out whether Prosodic is able to find generalizations reported in earlier work

(30)  Each line has five words, with no punctuation, so any difference between prose and verse can only depend on the choice and arrangement of words, not on line length.

(31)  (a)  Allowing no resolution (MaxS=1, MaxW=1, only 2 scansion/line) yielded results that were hard to interpret.
(b)  Allowing resolution (MaxS=1, MaxW=2) gave more sensible results.

(32)  Violation counts were normalized by dividing the sum of violations by the number of scansion and the number of syllables in the line.
5.1 Preliminary visualization

(33) English: Mean violation scores of phonological constraints

(34) Whitman is different (NoCLASH, NoLAPSE). Free verse scans like prose?
(35)  Finnish: Mean violation scores of phonological constraints

(36)  Lönnrot is different (PEAKPROM, NOCLASH). Stressed lights are favored in the Kalevala meter (see below). But why would clashes be avoided?

Mår.jät.ta, kó.re.a kúo.pus // se káu.an kó.to.na kás.voi
kór.ke.an í.son kó.to.na // é.mon tít.ta.van tů.vil.la

(37)  As for metrical constraints, looking at mean violations turns out not to be helpful.
5.2 Regression model

(38) We modeled the data using mixed-effects logistic regression (Bates et al. 2014):
(a) The binary dependent variable: prose vs. verse
(b) Predictors: Phonological and metrical violations, normalized and centered
(c) Random variable: author

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

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**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 | 3.36383 | -1.606 | 0.1083 |
| stress.s.not.u.norm 3.86222 | 1.52721 | 2.529 | 0.0114 * |

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Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(40) Which constraint violations predict which genre?

(a) PEAKPROM

<table>
<thead>
<tr>
<th>ENGLISH</th>
<th>FINNISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>prose</td>
<td>prose</td>
</tr>
<tr>
<td>WSP</td>
<td>prose</td>
</tr>
<tr>
<td>NO LAPSE</td>
<td>prose</td>
</tr>
<tr>
<td>NO CLASH</td>
<td>verse</td>
</tr>
</tbody>
</table>

(b) *W/PEAK

<table>
<thead>
<tr>
<th>ENGLISH</th>
<th>FINNISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>prose</td>
<td>n.s.</td>
</tr>
<tr>
<td>*S/UNSTRESSED</td>
<td>verse</td>
</tr>
<tr>
<td></td>
<td>prose</td>
</tr>
</tbody>
</table>
(41) **Phonology:** English and Finnish show the same differences between prose and verse: stress lapses are characteristic of prose; stress clashes are characteristic of verse.

(42) **Metrics:** We find that H&K’s claim is supported:
   (a) English verse controls weak positions and cares about strength, hence violations of *W*/PEAK are highly predictive of prose (p = 0.001).
   (b) Finnish verse controls strong positions and cares about stress, hence violations of *S*/UNSTRESSED ‘A strong position may not contain an unstressed syllable’ are predictive of prose (p = 0.05).

6. Conclusions

(43) Prose and verse differ in the choice and linearization of words:
   (a) PEAKPROM and WSP depend on word choice (up to lexical ambiguity).
   (b) NOCLASH and NOLAPSE depend on both word choice and linearization.

(44) Phonology is not just alternations and phonotactics (Shih 2014, Anttila 2016):
   (a) Phonology matters to the choices among words and allomorphs
   (b) Phonology matters to the linearization of words

(45) Further questions:
   (a) Which phonological properties remain constant across genres? Which vary?
   (b) Are there differences across prose types (e.g., oratorical prose, newswire)?

7. Open problems

(46) Function word stress. (i) Words considered unstressed in the sample (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 (119): a, ad, age, all, art, as, at, back, but, by, can’t, dare, de, di, did, die, do, does, 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

(47) English syllable weight. Assumptions: (i) (Unambiguously) closed syllables are heavy; (ii) Open syllable weight depends on the vowel: tense vowels count as heavy, lax vowels count as light. Some problems:

```
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
```
The syllabification of Finnish diphthongs: /au/, /eu/, /ou/, /iu/, /iy/, /ey/, /äy/, /öy/, e.g., va.pa.us ~ va.paus ‘freedom’, rak.ca.us ~ rak.kaus ‘love’ (work in progress)

(49) Phrasal stress (work in progress)

References

Steele, Timothy. 1999. All the Fun’s in How You Say a Thing, Athens: Ohio University Press.
Weide, R. L. 1998. The CMU pronouncing dictionary, release 0.6 [syllabification, stress, and weight tags added by Michael Speriosu].

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Partial effects (English)
Partial effects (Finnish)