Summary and comment on the dissertation:

“Greek Meter: An Approach Using Metrical Grids and Maxent”

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Dissertation defence of Erik Henriksson at the University of Helsinki
25 March, 2022

This handout may be downloaded from:
https://linguistics.ucla.edu/people/hayes/HayesComments.pdf
1. The typology of meter

- Paul Kiparsky suggests (2006) that metered verse is found in every single human culture.
- In pre-capitalist societies, active participation in the system of metered verse is the norm.
- There are two great systems, both found worldwide.

2. Stress-based meter

- I show this with a **metrical grid** (Lerdahl and Jackendoff 1983), a common way to depict rhythm.

```
  x x x x x
 x x x x x x x x
| | | | | | | |
The cúr- few tólls the knéll of párt- ing dáy
```

From Thomas Gray “Elegy Written in a Country Churchyard” (1750)

3. Quantitative meter — based on heavy and light syllables

- **Light syllable (˘):** any syllable ending in a short vowel.
- **Heavy syllable (−):** any other syllable

Example from Hausa (Chadic, Northern Nigeria), taken from Hayes and Schuh (2019)

```
  x x x x x x x x
  x x x x x x x
| | | | | | | |
ka noo ta ab du shaa ya boo
```

Kanòo ta Abdù shaa yàboo
Kano of Abdu receive praise
‘Kano of Abdu be praised’

4. The geographic/temporal scope of quantitative verse

- Arabic and its neighbors (Berber, Persian)
- India (both Indo-European languages and Dravidian)
- Japan
- South Pacific
- Finnish (**Kalevala** meter, an intriguing blend of stress and quantity)
- Ancient Greek (Erik’s focus) and Latin
5. The research questions of the field of metrics

- What are the rule systems, usually unconscious, intuitively obeyed by poets when (in some particular language/tradition) they arrange phonological material to manifest a particular (usually standardized) rhythm? (standardized rhythm = meter)
- Have we some hope of finding general principles, common to humanity, that regulate metrical systems everywhere?

6. This is a hard field in which to participate

- The participants are divided into several academic disciplines:
  - Linguistics, language & literature, psychology, music cognition
- Even in linguistics, there are many schools of metrics, which don’t communicate well.
- In light of this diversity, I particularly admire Erik’s literature review chapter, which is exceptionally broad and helpful.

7. The metrics research tradition in classical languages (Greek and Latin)

- This is exceptionally strong and goes back centuries.
- Anyone who seeks to read and understand classical poetry will benefit enormously from reading West, Raven, Allen, and similar authors.

8. Where is this dissertation trying to go beyond traditional scholarship?

- Take on question of “why” — can we move beyond the tradition of closely hugging the empirical ground, and achieve something useful with a more speculative/theory-grounded approach?
- Ideally, a new approach might not yield intuitive insight, but make progress on detail — a theory that lets us get us closer to the Ancient Greek data.
- It seems worthwhile to try to make use of recent ideas in music theory, linguistics, and statistics, to see if they can help us.

9. A key assumption of the dissertation

- The heavy and light syllables of Greek are being used to manifest an underlying rhythmic pattern.
- This pattern is depicted using the metrical grids we’ve already seen — a sequence of beats, arranged in an evenly-spaced hierarchy.
- So, for the trochaic tetrameter (p. 76), here is the grid, with some heavies and lights that can manifest it:
• What we think of as the “meter” is not the conventional formula of ⊘ and –. 
• Rather, it is the range of overt manifestations of the rhythm of the grid, using heavy and light syllables, that are permitted under the rule system.

10. What is the rule system like?

• Following a major trend in linguistics (starting with Optimality Theory, Prince and Smolensky 1993), we seek to reduce complex systems to interacting atoms of knowledge. 
• Erik’s atoms — constraints — are tiny imperative statements, each saying a specific, small-scale thing about how the syllables should line up with their grid.

11. Some sample constraints from the dissertation

• *SQUEEZE: don’t permit a heavy syllable to align with just one grid column

```
* x
```

➢ Rationale: one is worse than two, since heavy syllables are long.

• LONG → STRONG: situate a heavy syllable so it begins with a grid column that is (x much) tall.

```
* x  x
```

➢ Rationale: heavy syllables are perceptually prominent and suited to marking strong beats.

12. Can constraint-based theories yield explanation?

• I judge that all of Erik’s constraints are simple, intuitive, and supported by evidence in other domains (such as music). 
• So if we can combine these to actually describe Greek meters accurately and in detail, this could plausibly count as an explanation.
13. How to fabricate a complete grammar out of knowledge atoms

- This is the role of the theory of Maxent grammars.

14. Maxent starts with a sample space

- This is a large set of forms, big enough to cover any conceivable outcome.
- Here is the beginning of Erik’s sample space for Greek iambic trimeter:

```
○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ − ○ -...```

- Has Erik left any crucial strings out? See question period!

15. Assigning probability in Maxent

- In the calculations of the grammar, the constraints are used to assign a probability to each member of the sample space.
- Most members of the sample space get probability zero — the sequence is impossible as an instance of the meter.
- The positive probability cases will (if all goes well) match closely with the frequencies in which these sequences are actually used in verse.

16. The math of Maxent

- The math will not be covered here…
- … but it is actually not that complicated; for a tutorial I’ve written see: linguistics.ucla.edu/people/hayes/papers/HayesWugShapedCurve2021ShortVersion.pdf

17. Constraint weighting

- Every constraint comes with a weight (real number).
- Higher weights mean stronger constraints.

18. The weights are determined by finding the best fit to a data corpus

- Various algorithms exist to do this (Erik programmed one).

19. Summing up: the central material of this dissertation

- Title: Greek Meter: An Approach Using Metrical Grids and Maxent
- Quantitative meter can be regarded as a way of using heavy and light syllables to manifest a rhythmic pattern (notated with a metrical grid).
• The analysis can be built from very simple ingredients, using Maxent.
• The analysis can make quite accurate predictions, matching the data of a corpus.

KEY RESULTS OF THE DISSERTATION

20. The approach seems to be working pretty well

• One way to check accuracy is to make a scattergram, plotting the probability predicted by the analysis against the real-life frequencies of a metrical corpus.
• Here is the scattergram for the analysis of the trochaic tetrameter corpus.

![Scattergram](image)

*The fact that the data are lining up on the diagonal is good news; obtained for all four meters studied.*

21. The same principles that govern absolute presence/absence govern frequency

• Some variants are unusual in the corpus, and they are assigned low (but not zero) probability.
• But there is *no separate “probability component”*, as other theorists have proposed.
• It’s all one theory, with contextual flavors of the same basic constraints, and suitably set constraint weights.

22. How do we know when a Maxent model is right?

• The fields of statistics and computer science have been working on the problem of testing analyses, and have gradually built up an array of effective methods.
• Erik knows this literature and has brought one technique — **k-fold cross validation** — into Maxent metrics for the first time, to good effect.
• He also uses other methods; e.g. testing on randomly-created lines, showing that the models correctly classify them as non-verse.
• The same tests serve Erik well in his effective attack on the gridless theory of “Prosodic Metrics,” Chapter 6 — it performs poorly where Maxent performs well.

23. The Russian Method of metrical testing

• This is a venerable research method in metrics, originated by linguists and mathematicians in the Soviet Union during the mid 20th-century and pursued internationally since then.
• Problem in a nutshell, as stated for Greek:
  ➢ The words of Greek are unbalanced, favoring certain sequences of heavies and light.
  ➢ How do we know whether what we are seeing is a consequence of the metrical system, or rather just an accident of the kinds of word shapes Greek favors?

24. Erik’s proposal

• Following the core of the Russian method, he creates a language sample; basically nonsense sequences of Greek words that satisfy the minimal requirements of the meter.
  ➢ Example for trochaic tetrameter:

```
kökliomen ei ex Aphrodítēs Argunnídos
H LL L H H L L LH H H LH
mên ēmérōs te éria peribálemenos hōs
L H LH LH L LLLL L L H
ēgrapsen estin di ábathron leptón forei
L H L H H LL L H H H LH
```
• He finds the best weights to model this pseudo-corpus.
• Then, one constraint at a time, he checks the performance of the model when the constraint is set not at its best-fit value, but rather at its language-sample value.
• If grammar performance is not significantly worse, we learn that the effects of the constraint can be attributed to the inventory of Greek words, and not to the metrical system per se.

25. A gratifying consequence of Erik’s method

• Alarmingly, some of the constraints in his system, for some meters, get “backwards” negative weights — it looks like it’s better to violate them!
• This look like a big problem for the theory, but it turns out that for the most part, these are just artifacts of the inventory of word shapes in Greek, as the Erik’s implementation of the Russian method shows.
26. Material in the dissertation not covered here

- More or less a separate article (Chapter 7) taking on the hardest meters of Greek, using the concept of “metrical syncopation” pioneered by Paul Kiparsky.
- I’m convinced, but have nothing to add for purposes of this defense.
Questions

27. The bad candidate problem in the Sample Space — are you vulnerable?

Some of your Sample Spaces are surprisingly small. Here is one discussion from the dissertation:

\[
\text{if we schematize the Greek iambic trimeter as } \star \text{ } \star \text{ } \odot \times \star \text{ } \odot \times \star \times \odot \odot \ldots, \text{ by simple combinatorics the number of possible patterns comes out to be 322.}
\]

Obviously, it would be a disaster if your account proved vulnerable to the “missing good candidate” problem (see e.g. Karttunen 2006, attacking Kiparsky 2003). What are your reasons to think that your Sample Space suffices to stand in for the (far larger) full set of strings of \( \odot \) and \( \odot \)?

28. How does metrical acquisition work? Do poets internalize the Russian Method?

This question takes a realist stance toward grammars — they must be tacitly learned by speakers, based solely on exposure to language data.

So, please imagine Sophocles as a boy listening to performances of Aeschylus’s plays, as he acquires tacit knowledge of the principles of iambic trimeter.

He hears, among other things, the deviant metron types like \( \text{－－○－} \) whose high frequency you have explained using your version of the Russian method (that is: \( \text{－－○－} \) “seems too frequent”, but this is explained under the theory because Greek has so many words that better fit this shape.)

Question: What does young Sophocles tacitly make of this? Does the meter-acquisition system that Sophocles possesses (as a human) automatically compensate for these word-inventory effects? By the time Sophocles has grown up, what constraint weights has he internalized in his metrical grammar? Are these the disturbing “backwards” data-fitting weights, or weights that somehow contravene the data he is hearing? If the latter, is there some algorithm whereby he might accomplish this?

29. Typology

Last sentence of your disseration:
Furthermore, if Maxent models are coupled with a principled and structured set of constraints—as I have tried to do here—they invite consideration of their typological implications, an area where this study could be expanded on.

Please elaborate in brief, speculating where appropriate.