Visualizing sound as functional n-grams in Homeric Greek poetry

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Introduction

In this work we are looking for new ways to identify stylistic heterogeneity within the Iliad and Odyssey. As oral-formulaic poetry, the Greek epics may contain special evidence of the mutual relationships between poetics, cognition, and creativity.[1] At the same time, scholars of the digital humanities have long recognized that a successful digital criticism will find ways to return from statistics to more subjective understanding.[2]

Here, we assign n-gram counts to red, green, and blue color components in order to visualize patterns of sound within the poems.[3] The resulting images demonstrate viscerally that several well-known "set-piece" episodes within Homer's epics have distinct n-gram distributions.

Text, Sampling, and Controls

- Iliad and Odyssey downloaded from the Perseus Project[4] in XML
- concatenated, then broken into 20-line samples.

This was done 11 times: once without alteration, (**original** series); 10 more times, each time randomly re-ordering the lines of the concatenated poems before sampling (series **r0**...**r9**)

n-gram Distribution

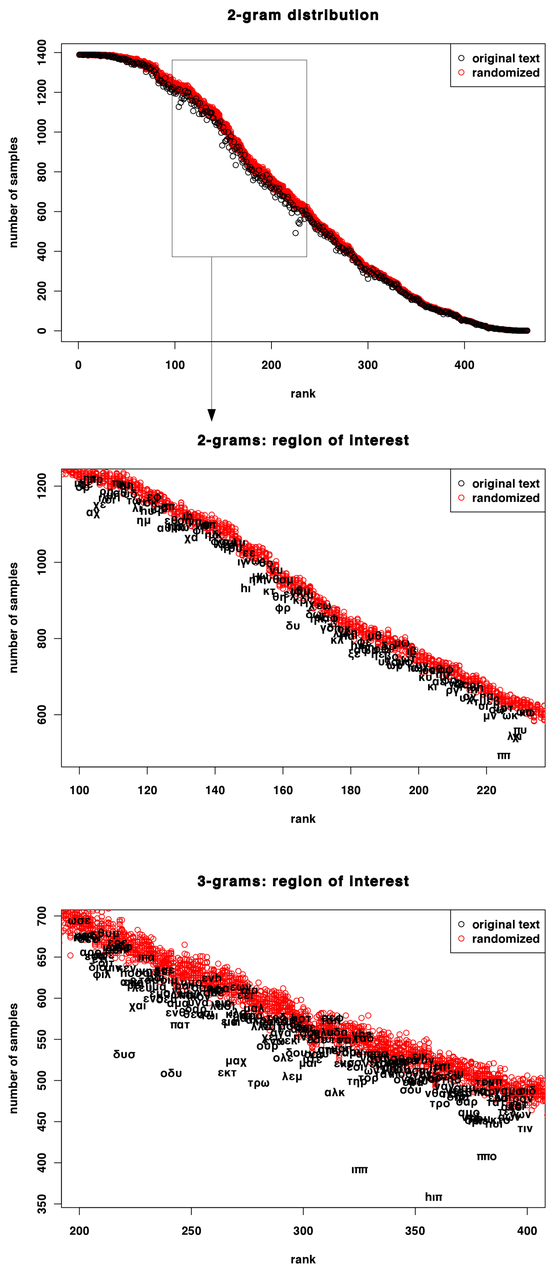
Trying to detect which might be the most interesting n-grams, we calculated *s*, the number of samples in which a given n-gram occurs.

When n-grams cluster in certain samples, other samples go without; *s* is then lower in **the original** than in the **r** series. The lower *s*, the more interesting the n-gram.

We quantify this by

$$\textbf{interest} = s_{\text{original}} - \text{mean}(s_{r0} \ldots s_{r9})$$

Exactly how interesting this is depends on the variability of *s*, so we also consider the standard deviation of (s_{r0} ... s_{r9}).



top 2-grams, by **interest**

n-gram	interest	sdev(s_r)
ττπ	-146	8
δυ	-105	9
αχ	-101	9
hι	-100	10
χι	-90	7
λκ	-86	7
φρ	-75	12
μν	-70	10
κτ	-69	15
πυ	-68	5

top 3-grams, by **interest**

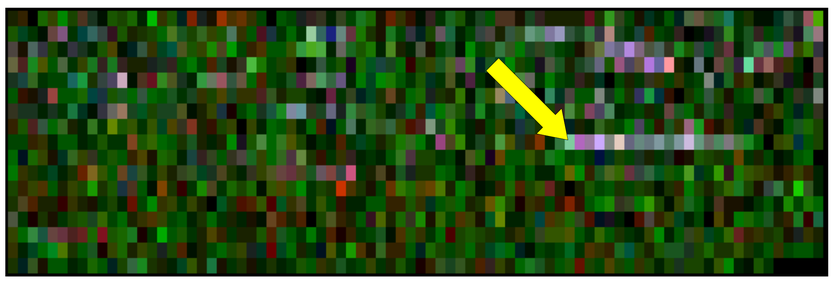
n-gram	interest	sdev(s_r)
ιττπ	-163	7
hιπ	-162	8
δυσ	-139	6
οδυ	-135	11
εκτ	-109	11
τρω	-101	11
πτπο	-100	9
αχι	-98	5
μαχ	-94	5
χιλ	-94	4

Example I: three 2-grams for "horse"

Two of the most interesting 2-grams, **hι** and **ττ**, are part of the word ἵππος, "horse."[6]
To these we added **ιπ**, which had a lower **interest** value.

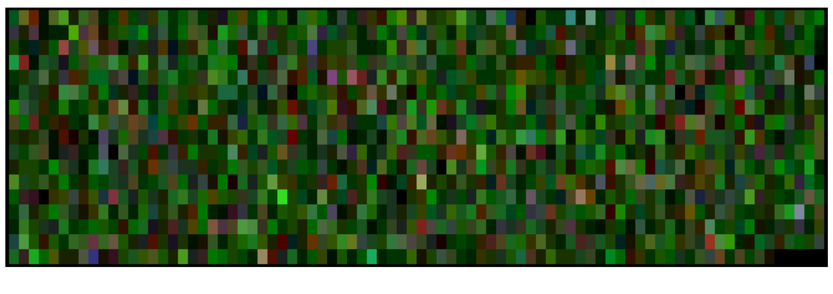
n-gram counts were scaled and translated into color values:

red	**hι**
green	**ιπ**
blue	**ττ**



original

The large bright region in series **original** corresponds to a set-piece, the chariot race held during the funeral games for Patroclus beginning at Iliad 23.259.



r0

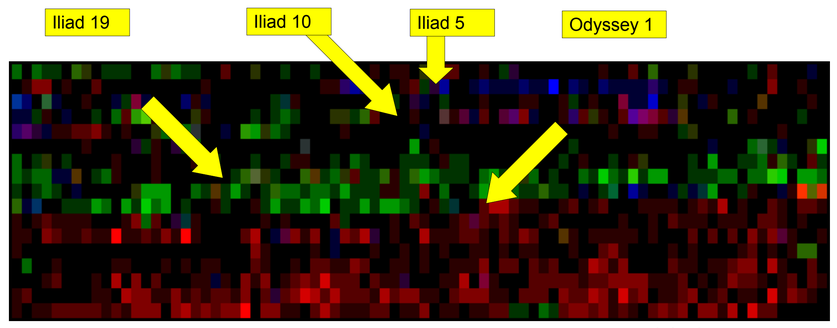
Example II: Three Heroes

Next we consider three 3-grams related to three independent content elements—each is a component of a Greek hero's name:

red	**δυσ**	Odysseus
green	**χιλ**	Achilles
blue	**τυδ**	Diomedes[5]

Each hero is foregrounded in a different part of the story:

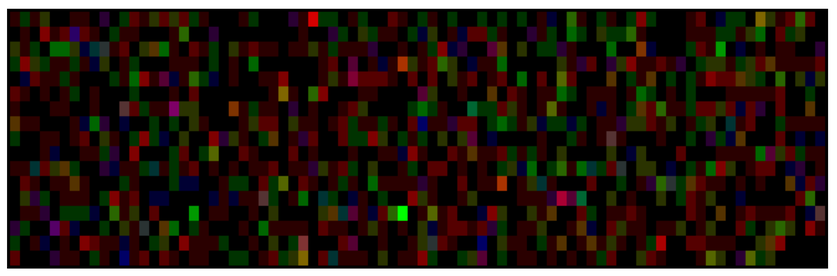
- Achilles in Iliad 19 and following
- Odysseus in the Odyssey
- Diomedes in Iliad 5



original

Note the purple section at Iliad 10. This is the "Night Raid" in which Diomedes and Odysseus worked together.

Not only do the colors show independent story elements; they also can represent their interactions.

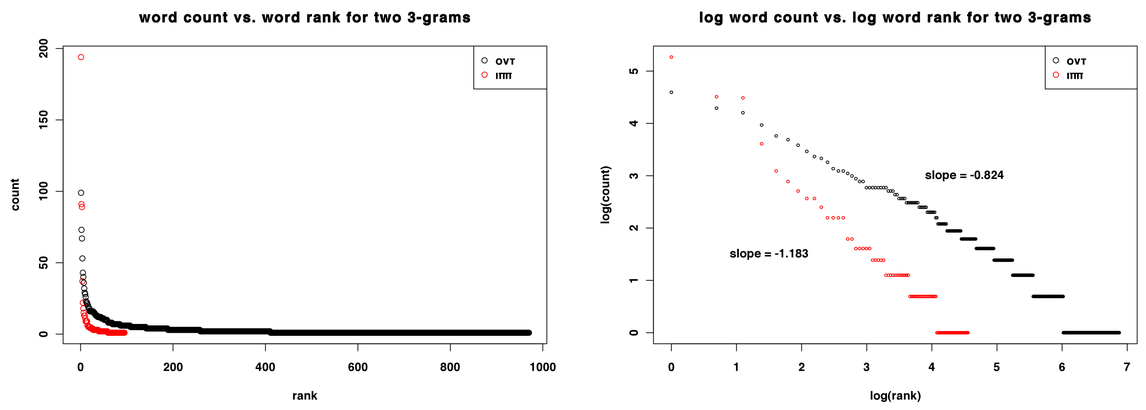


r0

Quantifying the Sound-Content Relationship

We measure both the number of words containing the n-gram, and the number of times each of those words occurs. The greater the lexical diversity of an n-gram, the less content-driven it is likely to be.

For example, compare the 3-grams **ιπτ** and **ovτ** both frequent and of high **interest** values.



These graphs show the number of times each word containing a given n-gram occurs in the text as a function of that word's rank. The right is a log-log version of the left.

Below are the top 10 words for each. **ovτ** shows a far greater diversity than **ιπτ**, in large part because it contributes to some common noun and verb inflections.

top words containing **ιπτ**

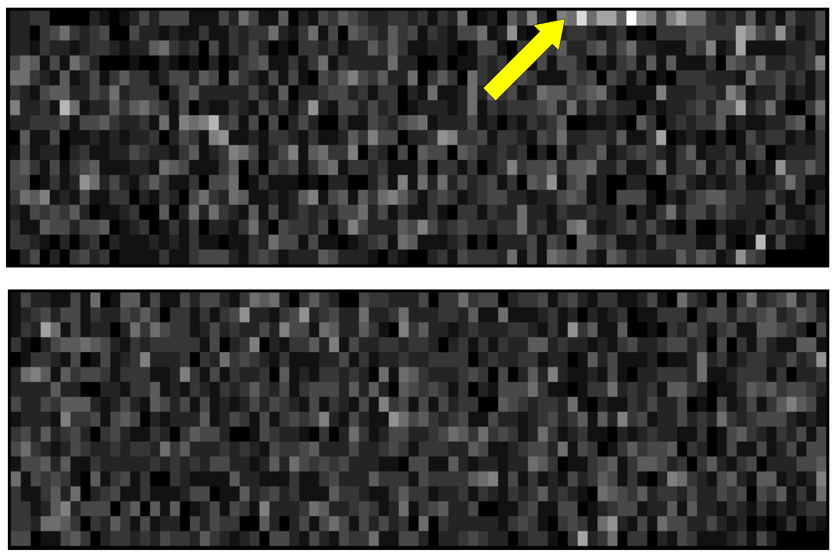
rank	count	word	meaning
1	194	ιπποuσ	"horses" (acc. pl.)
2	91	ιππων	"horses" (gen. pl.)
3	89	ιπποι	"horses" (nom. pl.)
4	37	ιππoτα	"horseman"
5	22	ιπποδαμοιο	"horse-tamer" (gen. s.)
6	18	ιπποισιν	"horses" (dat. pl.)
7	15	ιππον	"horse" (acc. s.)
8	13	ιπποισι	"horses" (dat. pl.)
9	13	ιππω	"horses" (nom./acc. d.)
10	11	ιππηλατα	"pertaining to horse-driving"

top words containing **ovτ**

rank	count	word	meaning
1	99	εοντα	"being"
2	73	ποντον	"sea" (acc. s.)
3	67	ηεπoντο	"they followed"
4	53	εχοντεσ	"having" (nom. pl.)
5	43	ποντωι	"sea" (dat. s.)
6	40	ηικoντο	"they arrived"
7	36	εγενoντο	"they were"
8	32	εχοντα	"having" (acc. s., nom./acc. pl.)
9	29	εοντεσ	"going"
10	28	γεροντοσ	"elder"

Example III: A Content-Independent Pattern?

Here, we used shades of grey to represent counts of a single 3-gram, **ovτ**. The bright region corresponds to the "Catalogue of Ships" inset piece at Iliad 2.484–761.



original

r0

Notes

1. Peabody, B. (1975) *The Winged Word: A Study in the Technique of Ancient Greek Oral Composition as Seen Principally Through Hesiod's "Works and Days."* Albany: SUNY Press.
2. Noted already by Packard, D. W. (1947) "Sound Patterns in Homer," *Transactions of the American Philological Association* 104:239–260.
3. We take our inspiration in part from Plamondon, M. (2009) "Computational Phonostylistics: Computing the Sounds of Poetry," presented at DHCS 2009.
4. Perseus Digital Library Project. Ed. Gregory Crane. http://www.perseus.tufts.edu. Accessed 2/1/2010.
5. By way of his patronym, "Son of Tydeus"
6. In composing the n-grams, we transcribe rough breathing as Latin **h**; iota subscript as adscript (regular **ι**); and final sigma with medial sigma as **σ**.