Epic Rhythm:
Metrical Shapes in Greek Hexameter

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IN THE *Homeric Hymn to Hermes*, the newborn god has just been caught. When Apollo sees the skins of his cows hanging in Hermes' cave—sure signs of his little brother's audacity—he tries to bind Hermes and vent his anger (403–416). But Hermes takes out an instrument of his own invention, the kithara, and plays so pleasantly (ἐρατὸν κιθαρίζων 423) and so orderly (κατὰ κόσμον 433) that Apollo relents and pledges eternal friendship for knowledge of the instrument (436–462). Yet it is not only the verbal descriptions of the kithara's "lovely sound" (ἐρατὴ … ἰωή 421) and soporific effect (ἥδυμον ὕπνον ἐλέσθαι 448–449) that should alert us to the quality of Hermes' song. From when Hermes starts to play, well into Apollo's response (409b–441), nearly every metrical shape is in place. Every dactyl (– ◡ ◡, as in μήτερα, "mother" [430]), spondee (– –, such as υἱόν, "son" [430], and the appositive group ἢ γάρ, "for she" [430]), pyrrhus (◡ ◡, λάχε, "obtain" [428]), choriamb (– ◡ ◡ –, ἀθανάτους, "immortals" [431]), almost every shape is in a more expected, or what O'Neill calls "localized," metrical position.[1] It is as if Hermes "soothed"

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[1] E. O'Neill, Jr., "The Localization of Metrical Word-Types in the Greek Hexameter: Homer, Hesiod, Alexandrians," *YCS* 8 (1942) 102–176. The one exception is the shape – ◡ ◡ – – of the appositive group at the beginning of Hermes' catalog of divinities, Μνημοσύνην μέν ("Memory" 429), which is very unexpected in its position. By expected, we mean not among the least expected ≈ 3.30% of shapes in their positions according to a definition we will develop in §1. Our definition of "metrical shape" is identical to that of O'Neill's "word-type"; for terminological distinctions see §1. The mean number of unexpected shapes per 181 metrical shapes (i.e., the number of words

(ἐπρήϋνεν 417) Apollo with familiar rhythms, a lullaby (449), each shape placed *kata kosmon* (433).[2] Here, at least, the meaning of the story can be felt through the rhythm of the poetry.

This article is a preliminary investigation into the expectancy of metrical shapes in the rhythm of Greek epic (seventh century BCE to fifth century CE). It argues that a new measure of metrical regularity according to expectancy enables readers to compare the distribution of metrical shapes and locate passages within texts with unusual metrical tendencies, such as Hermes' song above. Its source data are the metrical shapes, positions, and basic statistics of the roughly half-million words and appositive groups (for example a preposition and its object) from Homer's *Iliad* to Nonnus' *Dionysiaca*.[3] From these, it provides new stylistic information about the distribution of metrical shapes, especially when they occur at unexpected positions, in texts, authors, and characters, and how they may affect the experience of the poetry. This investigation opens possibilities for future research into the ways in which rhythm engages

or appositive groups from δεσμά ["bonds" 409b] to δῶρον ["gift" 442]), is 7.13 in the Archaic corpus; the percentage of windows of 181 shapes that have 0 or 1 unexpected shapes is 0.72%.

[2] For the *kosmos* of the hymn see O. Thomas, *The Homeric Hymn to Hermes* (Cambridge 2020) 48.

[3] S. A. Sansom and D. Fifield, "SEDES: Metrical Position in Greek Hexameter," *DHQ* 17.2 (2023). This study thus includes the smallest two prosodic domains that constitute complete metrical shapes: 1) the phonetic word and clitic group (i.e. enclitic and lexeme) and 2) the appositive group (lexical word with one or more nonlexical, e.g. particles), cf. A. Devine and L. Stephens, *The Prosody of Greek Speech* (Oxford 1994) 303–349, and, most recently, A. Blankenborg, *Audible Punctuation: Performative Pause in Homeric Prosody* (Washington 2022) 71–73, and "Mark the Words: Early Music's Representation in Writing," *Greek and Roman Musical Studies* 11 (2023) 13–14; C. Bozzone, *Homer's Living Language: Formularity, Dialect, and Creativity in Oral-Traditional Poetry* (Cambridge 2024) 92. Because rhythmic expectancy arises from what the audience likely had heard, prosodic apposition is a necessary factor in the assessment of rhythmic expectations; cf. e.g. S. Hagel, "How is Technology Useful in the Study of Ancient Music," *Greek and Roman Musical Studies* 10 (2022) 269–289, at 284. Appositive words are taken, with some additions, from S. Hagel, "Tables Beyond O'Neill," in F. Spaltenstein et al. (eds.), *Autour de la césure* (Bern 2004) 135–215, at 137.

expectations, including the style of authors, mimesis of generic models, rhetoric of speakers, and the *kosmos* of poetry.

Rhythm is an essential characteristic of epic poetry.[4] The "omnipresent," "immutable pattern of sound" gives epic a distinct identity and pleasure of "immersion."[5] Epic rhythm comes out of a long tradition of oral performance, where rhythmic units emerged from phrasal patterns and converged into the "special language" of verbal art.[6] Comparative studies

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[4] Meter is the "science of measuring verses," whereas rhythm is "simple verbal diction, based on the quantitative duration of the syllables," B. Gentili and L. Lomiento, *Metrics and Rhythmics: History of Poetic Forms in Ancient Greece* (Pisa 2008) 27–28; cf. Arist. *Rh.* 1408b; S. Liebhaber, "Rhythm and Beat: Re-evaluating Arabic Prosody in the Light of Mahri Oral Poetry," *JSS* 55 (2010) 163–182, at 168.

[5] E. Wilson, "I Began with Sound," *Public Books* (2023) https://www.publicbooks.org/i-began-with-sound/, accessed 5 December 2023.

[6] G. Nagy "Language and Meter," in E. J. Bakker (ed.), *A Companion to the Ancient Greek Language* (Malden 2010) 370–387, at 370; cf. Arist. *Poet.* 1449a (ἐκβαίνοντες τῆς λεκτικῆς ἁρμονίας). The bibliography on rhythm in Greek poetry is vast; representative arguments can be found in D. S. Raven, *Greek Metre* (London 1962) 45; W. S. Allen, *Accent and Rhythm. Prosodic Features of Latin and Greek: A Study in Theory and Reconstruction* (Cambridge 1972) 158; B. Peabody, *The Winged Words* (Albany 1975) 31; G. Nagy, "Metrical Convergences and Divergences in Early Greek Poetry and Song," *Historical Philology: Greek, Latin, and Romance* 87 (1992) 151–185; Devine and Stephens, *Prosody* 85–156, esp. 99–116; Gentili and Lomiento, *Metrics and Rhythmics* 262–266; P. Kiparsky, "Indo-European Origins of the Greek Hexameter," in D. Gunkel et al. (eds.), *Sprache und Metrik* (Leiden 2018) 77–127; E. Bakker, "Learning the Epic Formula," in C. Reitz et al. (eds.), *Structures of Epic Poetry* I (Berlin 2019) 81–98. For rhythm and formularity see e.g. A. Lord, *The Singer of Tales* (Cambridge [Mass.] 1960) 47; A. T. Edwards, "ΚΛΕΟΣ ΑΦΘΙΤΟΝ and Oral Theory," *CQ* 38 (1988) 25–30, at 29; M. P. Parry, *The Making of Homeric Verse: The Collected Papers of Milman Parry* (Oxford 1971 [1923]) 427 (cf. xxv), "[The repeated words and phrases] are like a rhythmic motif in the accompaniment of a musical composition, strong and lovely, regularly recurring, while the theme may change to a tone of passion or quiet, of discontent, of gladness or grandeur." Cf. recent work in language acquisition, e.g. S. Fujii and C. Y. Wan, "The Role of Rhythm in Speech and Language Rehabilitation: the SEP Hypothesis," *Frontiers in Human Neuroscience* 8.777 (2014) 1–15, at 10; A. Langus et al., "Rhythm in Language Acquisition," *Neuroscience and Biobehavioral Reviews* 81 (2017) 158–166.

in oral poetics suggest that rhythmic patterns can serve literary functions, such as to characterize dramatic passages.[7] And contemporary theorists of transhistorical poetics have explored how the rhythms of metrical verse "afford an organizing of temporal experience … in the moment of reading," coordinating aesthetic and social regularity.[8]

Metrical shapes contribute to the rhythm of epic in what is known as the "inner metric" of hexameter.[9] As O'Neill has shown, metrical shapes frequent or "localize in" only a few of all possible metrical positions.[10] Porter argues that this regularity generates "patterns of expectancy" that poets can "distort" to create "tension between what is expected and what is actually spoken."[11] In other words, each word or word group has a combination of long and short syllables, that is, a quantitative "shape"; the regular occurrence of these shapes in positions of

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[7] G. Herzog, "The Music of Yugoslav Heroic Epic Folk Poetry," *Journal of the International Folk Music Council* 3 (1951) 62–64; cf. H. Saussy, *The Ethnography of Rhythm: Orality and its Technologies* (New York 2016) 33.

[8] C. Levine, *Forms: Whole, Rhythm, Hierarchy, Network* (Princeton 2015) 79; cf. V. Barletta, *Rhythm: Form and Disruption* (Chicago 2020). For application to Greek epic see M. Ward, "ΓΑΜΕΣΣΕΤΑΙ/ΓΕ ΜΑΣΣΕΤΑΙ: Homer *Iliad* 9.394 and the Constitutive Role of Irregularity," *JHS* 141 (2021) 224–240. For earlier "formalist" positions see H. N. Porter, "The Early Greek Hexameter," *YCS* 12 (1951) 3–63, at 7–8.

[9] O'Neill, *YCS* 8 (1942) 105 n.2, defines the "outer metric" as the six feet of hexameter in combinations of dactyls ($- \smile \smile$) or spondees ($- -$) and the "inner metric" as "purely metrical limitation on this composition," such as Hermann's Bridge. For the rhythm of larger narrative and traditional units, such as type scenes of sacrifice within a *nostos* ("return") story, see J. M. Foley, *The Singer of Tales in Performance* (Bloomington 1995) 175–176; for the correspondences of rhythms of epic poetry and the physiological rhythms of the human body, Parry, *Homeric Verse* xxxiv, of thought, lxii. For rhythm as a product of quantity see e.g. K. Witte, "Wortrhythmus bei Homer," *RhM* 70 (1915) 481–523, and Parry, *The Making of Homeric Verse* 93. For Platonic views of rhythm as "a configuration of movement organized over time" see E. Benveniste, "The Notion of 'Rhythm' in Its Linguistic Expression," in *Problems in General Linguistics* (Miami 1971) 281–288, at 287; cf. Barletta, *Rhythm* 30.

[10] Cf. Hagel, in *Autour de la césure* 135–215.

[11] Porter, *YCS* 12 (1951) 8–9.

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the hexameter line forms a verbal rhythm that becomes ex-
pected by an audience and offers poets rhythmic material to
manipulate.[12] Musicologists such as David Huron have found
similar tension in musical rhythms, where rhythmic patterns
imprint on a listener's mind through "statistical learning" and
guide aspects of their attention:

> the evidence strongly suggests a form of statistical learning in
> which listeners perceive the world in a manner that corresponds
> to their past listening experience … Listeners appear to be sensi-
> tive to the frequency of occurrence of various rhythmic patterns,
> and their cognitive processing of rhythmic information is disposed
> to interpret stimuli in terms of familiar preexisting rhythms.[13]

By disrupting learned patterns of rhythm and sound, un-
expected sounds can trigger a variety of affective states in the
listener, such as increased attention, or surprise and its physical
manifestations in gasps of awe, chills of frisson, and automatic
laughter.[14] For readers of epic, awareness of the rhythmic char-

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[12] Thus when this paper uses the term rhythm it primarily means the syllabic quantities of words and word groups that are matched, or "textset," to the overarching meter of the hexameter line, cf. Devine and Stephens, *Prosody* 101. For "textsetting" see Bozzone, *Living Language* 79–80 (with bibliography), and R. Jackendoff, "Rhythmic Structure in Music and Language," in P. Kiparsky et al. (eds.), *Phonetics and Phonology* I *Rhythm and Meter* (San Diego 1989) 36–37. For notions of verbal rhythm in relation to music, see Blankenborg, *Greek and Roman Musical Studies* 11 (2023) 7 and 10.

[13] D. Huron, *Sweet Anticipation: Music and the Psychology of Expectation* (Cambridge [Mass.] 2006) 190–194; cf. M. R. Pearce, "Statistical Learning and Probabilistic Prediction in Music Cognition: Mechanisms of Stylistic Enculturation," *Annals of the New York Academy of Sciences* 1423 (2018) 378–395. For rhythm in poetry and music see e.g. D. Attridge, "Rhythm," in *Princeton Encyclopedia of Poetry and Poetics*[4] (Princeton 2012) 1195–1198.

[14] J. A. Slaboda, "Music Structure and Emotional Response: Some Empirical Findings," *Psychology of Music* 19 (1991) 110–120, at 113, and "Empirical Studies of Emotional Response to Music," in M. R. Jones et al. (eds.), *Cognitive Bases of Musical Communication* (Washington 1992) 33–50; Huron, *Sweet Anticipation* 283. For the relation of Huron's "statistical learning" in music to O'Neill's "localization" see C. W. Forestall and W. J. Scheirer, *Quantitative Intertextuality: Analyzing the Markers of Information Reuse* (Cham 2019) 39. For the *qualia* of music, or subjective feelings resulting from statistical properties of a stimulus, see Huron 362–363.

acter of a passage can provide not only insight into the potential cognitive/attentive experience of an early audience but also new ways to approach affect in and of texts, such as Apollo's unusual laugh in response to the "startling" sound of Hermes' kithara (*Hom. Hymn Hermes* 420–421).[15]

But O'Neill's breakthrough, while fundamental to our knowledge of regularity in *epos*, has been limited in its usefulness for reading texts. One problem is its measurement. Even with counts and percentages for a given metrical shape, it is often unclear what metrical positions are in fact unexpected for it, since shapes may localize in various positions to various degrees; percentages alone prove insufficient for comparison. Another is the difficulty of its application. Although looking up the statistics in the published charts for one metrical shape is easy enough, it soon becomes laborious to apply the information from printed tables of statistics to every word in a line, let alone all words in a passage, poem, or poetic corpus. Both problems have made it difficult to tell whether shapes, either expected or unexpected, are characteristic of books, speakers, or of epic as a genre, and to compare the expectancy of shapes of a passage *in situ*. Previous efforts to integrate this metrical information into commentary and interpretation have thus been limited, and there is much that remains unknown about the basic rhythm of metrical shapes in passages of poetry.[16]

In what follows, we attempt to increase the utility of metrical shapes for reading passages by analyzing their stylistics in three respects. After (§1) updating previous methodologies, we provide (§2) new stylometric information about the density of unexpected shapes in particular authors, poems, and books and

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[15] Cf. A. Becker, "Rhythm in a Sinuous Stanza: The Anatomy and Acoustic Contour of the Latin Alcaic," *AJP* 133 (2012) 117–152, at 141 on the capacity of poetic lines to "delight, arrest, and impel the reader's ear" based on statistical deviation. For Apollo's laughter as a response to sound see S. Halliwell, *Greek Laughter: A Study of Cultural Psychology from Homer to Early Christianity* (Cambridge 2008) 15 n.35; cf. A. Vergados, *The Homeric Hymn to Hermes* (Berlin 2013) 503, and Thomas, *The Homeric Hymn to Hermes* 376.

[16] For an example of the application of the data from Hagel's extension of O'Neill's charts see Thomas, *The Homeric Hymn to Hermes* 145 and 179 n.94.

(§3) a brief case study of the expectancy of shapes in the *Homeric Hymn to Hermes* before (§4) concluding. It is now possible to produce statistical analysis of the rhythm of metrical shapes in epic, compare them meaningfully, and see in vivid detail passages where metrical shapes localize or occur against expectation.

1. *Metrical shapes beyond O'Neill and Hagel*

The present study focuses on metrical shapes as quantitative rhythmic units. As such, it completes O'Neill's study of "word-types," i.e. metrical shapes such as $-\smile\smile$, which was based on a limited sample of a few texts and omitted appositive groups.[17] Our study diverges, however, from a more recent analysis of localization, that of Hagel's "word shapes."[18] Hagel measures the localization of phonetic-metrical compounds and appositive groups with variable quantities, breaking metrical shapes into smaller categories of "word shapes." For example, Hagel combines O'Neill's two shapes $--\smile$ and $---$ into one "metrical shape" $--\overline{\smile}$, whose final syllable is an anceps (may be either long or short); then subdivides that into ten "word shapes" according to their initial and final vowels or consonants (or double consonants) and final quantities: for example C$--\overline{\smile}\breve{V}$C as found in the word κοίλῃσιν ("hollow" *Il.* 1.26).[19] Hagel shows that word shapes, like O'Neill's metrical shapes, also localize and provide

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[17] C. J. Ruijgh, "ΜΑΚΡΑ ΤΕΛΕΙΑ ΕΤ ΜΑΚΡΑ ΑΛΟΓΟΣ: Le prolongement de la durée d'une syllable finale dans le rythme du mot grec," *Mnemosyne* 40 (1987) 313–352, treats ῥυθμός in Dionysius of Halicarnassos as word type; cf. Blankenborg, *Audible Punctuation* 37–39: "in his approach, rhythm is understood as the perceptible recurrence of certain rhythmical word types, like the iamb ($\smile\,-$)" (37).

[18] Hagel, in *Autour de la césure* 135–215; cf. C. W. Forstall, *De Homeri Ingenio: Aspects of Oral-Formulaic Composition in the Iliad* (diss. SUNY Buffalo 2014) 55–93. For localization of phonemes see D. Bouvier, "Localisation des lettres et des phonèmes dans l'hexamètre homérique: développement d'une intuition refoulée de Ferdinand de Saussure," *Cahiers Ferdinand de Saussure* 68 (2015) 149–169.

[19] Hagel, in *Autour de la césure* 181–188, at 185–186. Cf. Allen, *Accent and Rhythm* xiii. Hagel's definition of "metrical shape" thus differs from O'Neill's, since Hagel's shapes at times include variable quantities (anceps), which is a higher level of abstraction than O'Neill's.

valuable information on the metrical tendencies of word forms. In contrast, the present study addresses the rhythmic expectations generated by metrical shapes alone, which localize and generate patterns of expectancy through statistical learning in ways that may affect the stylometry of the text.

Our study makes use of a statistical formula we call *expectancy*.[20] The intuition is that the distribution of metrical shapes over *sedes* creates an expectation for an average or "typical" number of occurrences of a shape at any *sedes*, and for how much the counts vary across *sedes*. Expectancy, denoted by the variable *z*, is the amount by which an observed count *x* differs from the mean, in units of standard deviations.[21] Two appendices report expectancy *x* and *z* data for the metrical shapes of words and appositive groups in major poems of the hexameter corpus.[22] The Appendix linked to this paper is a synopsis of the distribution of metrical shapes in epic, while the second appendix (online) provides the diachronic distribution of each shape by text.[23] Expectancy allows for valid and meaningful comparisons of shapes between texts, authors, and eras, more than localization scores or percentages alone. Take for example the distribution of the anapaest ($\smile \smile -$) over *sedes*, shaded for expectancy (Table 1):[24]

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[20] Cf. S. A. Sansom, "*Sedes* as Style in Greek Hexameter: A Computational Approach," *TAPA* 151 (2021) 439–467, at 447, and Sansom and Fifield, *DHQ* 17 (2023) §5.

[21] The mean is a weighted average of the vector of observed counts $x_1, \ldots, x_n$, each weight being the count itself: $\mu = \Sigma(x_i \times x_i)/\Sigma(x_i)$. The standard deviation is likewise weighted by the number of occurrences: $\sigma = \sqrt{(\Sigma(x_i \times (x_i - \mu)^2)/\Sigma(x_i))}$. The expectancy of the count *x* is then the standard score: $z = (x - \mu)/\sigma$.

[22] This corpus is the same as that of the SEDES program; cf. Sansom and Fifield, *DHQ* 17 (2023) §6.

[23] The online appendix, as well as the code and data, is available at https://github.com/sasansom/epic-rhythm.

[24] Statistics are based on the distribution of shapes within a text or collection of texts, such as the *Iliad* or *Homeric Hymns*. The SEDES program tabulates *sedes* from the *beginning* of shapes, in a slight modification of O'Neill; cf. Sansom, *TAPA* 151 (2021) 445.

Work	1	2	2.5	3	4	4.5	5	6	6.5	7	8	8.5	9	10	10.5	11	12	Total (Σx)
Iliad	×	478 (11.8%) −1.514			1,205 (29.9%) −0.253			1,891 (46.9%) +0.936			440 (10.9%) −1.580			20 (0.5%) −2.308			×	4,034
Odyssey	×	322 (10.9%) −1.516			816 (27.6%) −0.561			1,563 (52.9%) +0.883			240 (8.1%) −1.675			15 (0.5%) −2.110			×	2,956
Hom. Hymns	×	49 (9.9%) −1.904			177 (35.9%) +0.176			213 (43.2%) +0.761			53 (10.8%) −1.839			1 (0.2%) −2.684			×	493
Theog.	×	24 (10.0%) −1.616			68 (28.2%) −0.403			117 (48.5%) +0.947			32 (13.3%) −1.395			0 (0.0%) −2.277			×	241
WD	×	26 (10.8%) −1.401			58 (24.1%) −0.695			130 (53.9%) +0.894			25 (10.4%) −1.423			2 (0.8%) −1.931			×	241
Shield	×	18 (12.7%) −1.470			43 (30.3%) −0.124			63 (44.4%) +0.953			17 (12.0%) −1.524			1 (0.7%) −2.386			×	142
Argon.	×	133 (12.0%) −1.902			389 (35.1%) −0.224			546 (49.3%) +0.805			37 (3.3%) −2.532			2 (0.2%) −2.761			×	1,107
Callim. Hymns	×	28 (17.6%) −1.254			30 (18.9%) −1.195			98 (61.6%) +0.785			3 (1.9%) −1.982			0 (0.0%) −2.069			×	159
Phaen.	×	21 (6.0%) −2.328			130 (37.0%) +0.120			157 (44.7%) +0.726			42 (12.0%) −1.856			1 (0.3%) −2.777			×	351
Theoc.	×	59 (12.0%) −1.771			199 (40.4%) +0.599			189 (38.3%) +0.430			43 (8.7%) −2.042			3 (0.6%) −2.719			×	493
Quint. Smyrn.	×	184 (17.0%) −1.054			262 (24.2%) −0.416			452 (41.7%) +1.137			180 (16.6%) −1.087			6 (0.6%) −2.509			×	1,084
Dion.	×	349 (13.5%) −1.826			927 (35.8%) −0.073			1,212 (46.9%) +0.791			97 (3.8%) −2.590			1 (0.0%) −2.881			×	2,586
TOTAL	×	1,691 (12.2%) −1.549			4,304 (31.0%) −0.252			6,631 (47.7%) +0.903			1,209 (8.7%) −1.788			52 (0.4%) −2.362			×	13,887

TABLE 1:
∪ ∪ – by count (*x*), percentage, and expectancy *z*-score
(darker shades are more unexpected)

Each row of Table 1 shows expectancy computed within a single text. Since the distribution of the shape ∪ ∪ – is different in each text, the same percentage may represent different *z*-scores in different texts. For example, anapestically-shaped words occur at around the same frequency near the beginning of the line (i.e. *sedes* 2) in both the *Homeric Hymns* and the *Theogony*, around 10%. But despite this similarity in frequency, measuring

by standard distribution shows that the shape is more un-expected in the *Hymns* (−1.904 vs. −1.616), which results in a darker shading in the visualization. The same is true of different metrical shapes at the same *sedes*. As shown in the Appendix (in which expectancy is computed over the full corpus), although spondees (– –) appear with less frequency than anapaests (⌣ ⌣ –) at *sedes* 10 (0.0% [6/40,131] vs. 0.4% [52/13,887]), they have a greater expectancy in that position ($z = −1.697$ vs. −2.362), be-cause the distribution of spondaically-shaped words over other *sedes* is generally more variable. The definition of expectancy in terms of standard deviations shows how *counts* differ from what is "typical" in a way that plain percentages do not. In addition to tables, computed expectancies may also be visualized in the text itself by shading each word according to the expectancy of its metrical shape, for instance in *Homeric Hymn to Hermes* 13 (as above, darker shades indicate lower *z*-scores):[25]

καὶ τότ' ἐγείνατο παῖδα πολύτροπον, αἱμυλομήτην

and then she (Maia) bore a child, many-wayed, plotting-twists.

While most shapes are expected in their given positions (within a range of $z = −0.52$ to +0.61), the shape of ἐγείνατο (⌣ – ⌣ ⌣) is very unexpected ($z = −5.40$) at *sedes* 2.5; it is much more com-mon, for example, at *sedes* 6.5.

Similar to the analysis of lemmata (or all morphological forms of a word) in prior studies, the above method provides basic information about when and where metrical shapes are ex-pected.[26] Such information is beneficial to future metrical and linguistic study of hexameter, but also, as will be demonstrated below, to readers of epic who are interested in the potential stylistic effects of meter. We suggest that regularity of metrical shapes characterizes a passage, speech, text, or author in aggre-gate. A general impression or affective state may arise from ex-treme rhythmic regularity, such as the impression of somnolence or "sweetness" in the *Hymn to Hermes* passage discussed above; or

[25] The metrical scheme would be visualized thus: ₁[– ⌣] ₂.₅[⌣ – ⌣ ⌣] ₅[– ⌣] ₆.₅[⌣ – ⌣ ⌣], ₉[– ⌣ ⌣ – –]. This visualization calculates expectancy according to the Archaic corpus.

[26] Sansom, *TAPA* 151 (2021) 439–467.

unexpected irregularity, such as general increase in attention or other affective states found in psychological studies of musical rhythm. The potential for the latter increases in certain texts or individual books or poems that contain a higher density of ir-regular shapes, a topic that is the focus of the following section.

2. *Density of unexpected metrical shapes*

For the purpose of analysis, we will call a shape/*sedes* com-bination "unexpected" when it has an expectancy *z*-score less than or equal to −2.0; that is, the number of occurrences of the shape at that *sedes* is at least 2 standard deviations lower than the weighted mean number of occurrences at any *sedes*. The specific threshold is arbitrary and is only for the convenience of con-verting the continuous quantity of expectancy into a yes/no binary. By this definition, 3.30% (13,160/399,327) of words or appositive groups in the epic corpus have a metrical shape that is unexpected at the *sedes* at which it appears.

Unexpected shapes are unevenly distributed. For example, 4.00% (3,551/88,796) of shapes in the *Iliad* are unexpected (an average of 147.96 per book, which themselves average roughly 3,700 shapes), with Book 10 having the least proportion of unexpected shapes at 3.27% (108/3,303) and Book 2 having the greatest at 4.68% (227/4,850). Below, we show the overall per-centage of unexpected shapes in particular texts, as well as the book or poem with the lowest and highest rates of unexpected shapes (Table 2).[27]

We may note a general diachronic trend toward fewer un-expected shapes. Apollonius of Rhodes, Callimachus, and Non-nus put shapes in expected places more often than other poets.[28]

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[27] Callimachus knew Homer's metrical tendencies but not, of course, vice versa. For this reason, the expectancy of Archaic texts is measured relative to the Archaic corpus only; that of Hellenistic texts from the Archaic and Hel-lenistic corpus; and that of Imperial texts from the entire corpus.

[28] This trend towards metrical regularity and the "severe style" in Hellenistic authors, especially Callimachus, is discussed e.g. in A. S. Hollis, *Callimachus: Hecale*[2] (Oxford 2009) 17; F. Cairns, *Hellenistic Epigram: Contexts of Exploration* (Cambridge 2016) 232; and M. Fantuzzi and R. Hunter, *Tradition and Innovation in Hellenistic Poetry* (Cambridge 2004) 44 ("a series of refinements

Work	Overall rate of unexpected metrical shapes	Book with lowest rate of unexpected metrical shapes	Book with highest rate of unexpected metrical shapes
Iliad	4.00% (3,551/88,796)	3.27% (108/3,303) Bk. 10	4.68% (227/4,850) Bk. 2
Odyssey	3.91% (2,667/68,293)	2.70% (87/3,222) Bk. 10	4.62% (159/3,444) Bk.17
Homeric Hymns	3.91% (508/12,994) 3.95% (423/10,704) [*Hymns* 2–5]	0.00% (0/88) *Hymn* 8 0.00% (0/24) *Hymn* 12 0.00% (0/18) *Hymn* 13 0.00% (0/29) *Hymn* 16 0.00% (0/26) *Hymn* 17 0.00% (0/31) *Hymn* 21 0.00% (0/20) *Hymn* 23	10.53% (8/76) *Hymn* 29
Theogony	3.55% (201/5,663)	-	-
Works and Days	3.38% (158/4,669)	-	-
Shield of Heracles	3.88% (104/2,683)	-	-
Ap. Rh. *Argon.*	2.09% (668/32,027)	1.83% (179/9,761) Bk. 4	2.55% (180/7,064) Bk. 2
Callim. *Hymns*	1.52% (79/5,200)	0.97% (6/619) *Hymn* 2	1.77% (10/564) *Hymn* 1
Aratus *Phaen.*	3.27% (201/6,149)	-	-
Theocr. *Idylls*	3.12% (445/14,273)	1.17% (3/256) *Idyll* 20	6.35% (53/835) *Idyll* 15
Quintus Smyrn. *Fall of Troy*	3.74% (1,836/49,063)	3.35% (123/3,677) Bk. 14	4.46% (165/3,701) Bk. 6
Nonnus *Dion.*	2.50% (2,742/109,517)	1.79% (33/1,840) Bk. 34	3.54% (69/1,951) Bk. 46

TABLE 2:
Density of Unexpected Metrical Shapes by Work and Book

Aratus and Theocritus, however, interrupt this tendency and have only slightly fewer unexpected shapes than Archaic poets; Quintus of Smyrna has nearly the same average as the *Iliad*. But despite Theocritus' closeness to Archaic figures, the density of unexpected shapes in his poetry ranges far more widely than to Homer; in contrast to the *Iliad* and *Odyssey*, whose difference is only about 1.4% to 1.9% between the highest and lowest fre-

and prohibitions governing word-breaks and possible combinations means that the Callimachean hexameter is a very strict instrument, which imposes a marked intellectual formalism on all his poetry in this metre").

quencies, the difference in Theocritus' range is 5.2%. The rhythm of Theocritus' metrical shapes varies far more in his oeuvre than does Homer's.

Some individual books or poems have a surprisingly large number of unexpected shapes, which may tell us more about their rhythmic character. Theocritus *Idyll* 15, which depicts women attending a festival of Adonis, has over twice as many unexpected shapes as we would expect based on his corpus (6.35% [53/835] compared to average 3.12%); this difference exceeds those of other Hellenistic authors, e.g. Callimachus (highest 1.77% to average 1.52%), and Homer, too (4.68% to 3.96%).[29] From these figures, *Idyll* 15 appears to be rhythmically distinct, at least in its density of unexpected metrical shapes. A better understanding of the poem's distinctive rhythm could intervene in current scholarship, which debates its Homeric character and its indebtedness to rhythmic prose mime, such as that of Sophron.[30] Theocritus adopts the hexameter, but his

[29] The following are marked with unexpected shapes in *Idyll* 15 (with the *sedes*, shape, and line number): ὅτι καὶ νῦν ($_2$[‿ ‿ – –], 2), ὁ πάραρος ($_2$[‿ ‿ –], 8), τὸν τεόν ($_3$[– ‿ ‿], 11), ὡς ποθορῇ ($_9$[– ‿ ‿ –], 12), τὰν πότνιαν ($_7$[– – – –], 14), ἀργυρίω ($_7$[– ‿ ‿ –], 18), ἀκούω ($_{6.5}$[‿ – –], 23), καὶ ἰδοῖσα ($_6$[‿ ‿ – ‿], 25), ἀεργοῖς ($_{6.5}$[‿ – –], 26), πρότερον ($_{10}$[‿ ‿ –], 29), ὕδατος ($_8$[‿ ‿ –], 29), ὁκοῖα ($_{2.5}$[‿ – ‿], 32), καθαρῷ ($_{10}$[‿ ‿ –], 36), ἀργυρίω ($_7$[– ‿ ‿ –], 36), καὶ τὰν ψυχάν ($_6$[– – – –], 37), ἀπέβα τοι ($_6$[‿ ‿ – –], 38), τὸν μικκόν ($_6$[– – –], 42), τὰν αὐλείαν ($_6$[– – – –], 43), παρέρπων ($_{6.5}$[‿ – –], 48), ὡς ἄγριος ($_7$[– ‿ ‿ –], 53), ἀνέστα ($_{2.5}$[‿ – ‿], 53), διαχρησεῖται ($_6$[‿ ‿ – – –], 54), τὸ βρέφος ($_8$[‿ ‿ –], 55), πείρα θην ($_6$[– – –], 62), γυναῖκες ($_{2.5}$[‿ – ‿], 64), καὶ ὡς Ζεύς ($_{6.5}$[‿ – –], 64), τὰν χέρα μοι ($_7$[– ‿ ‿ –], 66), Εὐνόα ($_3$[– ‿ ‿], 76), ὦ δειλά ($_7$[– – –], 76), σοφόν τοι ($_{6.5}$[‿ – –], 83), ἄνθρωπος ($_{10}$[– – –], 83), ὃς ἀμῶν ($_{6.5}$[‿ – –], 94), κενεάν ($_8$[‿ ‿ –], 95), ἀθανάταν ($_7$[– ‿ ‿ –], 106), εἰκυῖα ($_{10}$[– – –], 110), ἑλένᾳ ($_8$[‿ ‿ –], 110), ὥρια ($_3$[– ‿ ‿], 112), ἐν ὑγρῷ ($_{8.5}$[‿ – ‿], 117), οἱ δέ τε ($_3$[– ‿ ‿], 120), μίλατος ($_2$[– – ‿], 126), τὰν σαμίαν ($_7$[– ‿ ‿ –], 126), πτύοντα ($_{10}$[– – –], 133), καὶ ἐς νέωτ' ($_{6.5}$[‿ – –], 143), ἀφίκη ($_8$[‿ ‿ –], 144).

[30] For the former see M. Chaldekas, "An Intersectional Approach to Theocritus, *Idyll* 15," *Helios* 49 (2022) 1–24, at 11; S. Reece, *The Stranger's Welcome: Oral Theory and the Aesthetics of the Homeric Hospitality Scene* (Ann Arbor 1993) 320; for the latter, S. Miles, "Performing Mime in the *Idylls* of Theocritus: Metrical Mime, Drama, and the 'Everyday' in Theocritus, *Idylls* 2, 14, 15," in P. Kyriakou et al. (eds.), *Brill's Companion to Theocritus* (Leiden 2021) 154–175.

rhythm, at least of metrical shapes, is un-Homeric. Perhaps like other metrical features, the positioning of shapes also contributes to what Miles has described as "the audial impact of (Theocritus') works and the implications of tones and resonances with past poetry."[31]

The expectancy of shapes allows for future inquiry of this sort not only into the style of different authors, but also how rhythm relates to the possible style of individual books and poems. And like books, shorter passages may also deviate from typical metrical distributions. In what follows, we return to the *Homeric Hymn to Hermes* to briefly examine the literary contexts of both unexpected and overly regular rhythm of metrical shapes within the hymn.

3. *Rhythm, expectancy, and kosmos in the Homeric Hymn to Hermes*

The rhythm of the *Homeric Hymn to Hermes* has been the subject of some debate. In its larger structure, West claims that "(the hymn has) no command of the even tempo appropriate to epic storytelling."[32] But Thomas demonstrates how the poem "makes use of complex internal patterning at every level" (39), where corresponding passages develop themes such as *charis* ("divine favor" 36) and *kosmos* ("intricate, pleasing structure" 39).[33] When Apollo prosecutes Hermes for stealing his cattle, he deploys "an arsenal of rhetorical strategies" that include "rhythm, alliteration, syntactic curtness, understatement and perhaps sarcasm."[34] Hermes responds to this rhetorical onslaught with rhythmic stylings of his own, ending 11 out of 17 lines with the pattern $[\smile - -]_{\text{VERB}}$ with six preceded by $[- \smile]$ (261–277).[35] Thus far, then, rhythm has been suggested to work on both a large and a small scale in the organization of the poem: as thematic response between longer intratextual passages, and as a rhe-

[31] Miles, in *Brill's Companion to Theocritus* 167.

[32] M. L. West, *Homeric Hymns, Homeric Apocrypha, Lives of Homer* (Cambridge [Mass.] 2003) 12.

[33] Cf. Vergados, *The Homeric Hymn to Hermes* 125, for the larger-ring composition of the poem.

[34] Thomas, *The Homeric Hymn to Hermes* 292, cf. 280.

[35] Vergados, *The Homeric Hymn to Hermes* 24 and 423.

torical feature of interpersonal dispute.

Metrical shapes play a role in both the macro- and micro-rhythms of the hymn. From a more distant vantage point, we see that passages vary in the number of unexpected shapes ($z \leq -2.0$). We can view this variation as a graph of unexpected shapes in the poem (*fig.* 1):[36]
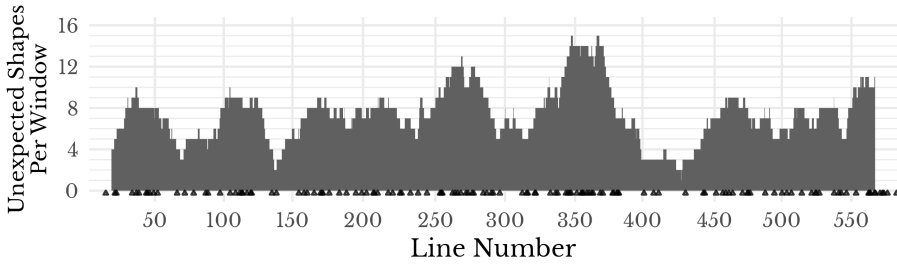

Figure 1: Number of unexpected metrical shapes in windows of 181 shapes in *Homeric Hymn to Hermes*, with pips indicating their location

There are peaks, where passages have more unexpected shapes (max = 15), and troughs, with few to no unexpected shapes. Such a graph thus identifies runs of lines that we could consider arrhythmic (peaks) or, conversely, overly rhythmic (troughs) according to the expectancy of metrical shapes. Both types—arrhythmic and overly rhythmic passages—may tell us something about the style and meaning of their respective places in the narrative. We suggest that this is the case for the hymn and will consider a few of the outstanding sections.

Surprisingly, thematically related passages at times correspond rhythmically as well. This correlation is especially apparent for the theme of song. Hermes sings two songs in the hymn. As mentioned at the beginning of this paper, Hermes' theogonic song that pacifies Apollo near the poem's end is overly

[36] The method for counting unexpected shapes is called the sliding-window technique, whereby the formula counts the number of unexpected shapes within a given number of shapes, reports the count, then shifts one shape over and repeats; cf. S. Katajamäki, "Analyzing Irregular Rhyme Sequences: Methodological Experiments with Lauri Viita's *Kuknor*," in V. Sykäri et al. (eds.), *Rhyme and Rhyming in Verbal Art, Language, and Song* (Helsinki 2022) 246–263, at 253.

rhythmic in its metrical shapes (409b–441). From the moment Hermes breaks from Apollo's bonds (δέσμα 408) well into Apollo's enamored response to Hermes' song (δῶρον 442), there is only one unexpected shape out of 181 shapes over 32 lines (– ◡ ◡ – –, Μνημοσύνην μέν 429). For context, in the Archaic corpus only 0.72% of passages of this length have 1 or less unexpected shapes.[37] But this is not the first section with overly expected rhythm. The first is, in fact, Hermes' other song, sung immediately after he invents the lyre at the poem's beginning (52–67). From when Hermes "improvises" on the "lovely plaything … in scales" (ἐξ αὐτοσχεδίης 55; τεῦξε, φέρων, ἐρατεινὸν ἄθυρμα … κατὰ μέρος 52–53) singing of his birth in the cave (61), to his first thoughts of something to eat (χρειῶν ἐρατίζων … δείπουσι 67), there are no unexpected shapes (0/78).[38] Scholars have previously noted how the two songs are intricately related and reflect Hermes' social transition from the domestic sphere of the first song to the social hierarchies of the gods in the second.[39] We can now see that the songs share overly expected rhythm of metrical shapes as well.

Hermes' second song also responds to themes and rhythm of the 'sacrifice' of Apollo's cows that follows their theft (120–154). After Hermes butchers two of the cows, he cooks them on spits. From when he begins to cut the meat (ταμὼν κρέα 120) to when he burns the carcasses, tosses his sandals into the Alpheios (139), and crawls back into his crib cradling his lyre (χέλυν ἐρατὴν ἐπ᾿

[37] The scene before is likewise overly rhythmic in its position of metrical shapes. After Hermes finishes his final case to Zeus, Zeus laughs, bids him show Apollo where the cows are hidden, and he does so; from 381 (καὶ δαίμονος) to 407 (κράτος), there is only 1 unexpected shape (₂[– – ◡] Ἑρμῆς μέν 401, 1/139 shapes, of which only 2.70% of windows have 1 or less unexpected shapes).

[38] 4.18% of passages of 78 shapes in the Archaic corpus have no unexpected shapes.

[39] S. I. Johnson, "Myth, Festival, and Poet: The *Homeric Hymn to Hermes* and its Performative Context," *CP* 97 (2002) 109–132, at 124, contrasts the hymn's structure with other instances of the myth and suggests that this change is due to the social significance of Hermes' raid of Apollo's cattle. Cf. J. S. Clay, *The Politics of Olympus: Form and Meaning in the Major Homeric Hymns*[2] (London 2006) 140.

ἀριστερὰ χειρὸς ἐέργων 153), there are only two unexpected shapes out of 189 (only 2.13% of windows of this length have two or less shapes in the Archaic corpus). A rhythmic pattern emerges between this scene and his previous activity of crafting and playing the lyre. Hermes crafts the lyre out of the turtle (33–52a, somewhat rhythmically unexpected [8/104, 5.2%, of windows have that many or more unexpected shapes]) then plays the lyre (52b–67a, overly rhythmic [0/78, 4.18%]); Hermes craftily (δολίης … τέχνης 76) steals Apollo's cattle (105–120a, rhythmically unexpected [8/90, 2.43%, with 8 or more unexpected shapes]), then carefully cooks two in proper fashion (120b–154a, overly rhythmic [2/189, 2.13%]). The final song of Hermes recalls these two passages of cultural performance (music, food preparation) in its themes and diction.[40] In addition to these shared themes and language, the passages are likewise marked by overly expected rhythm.

Even more striking is the correlation between the expectancy of metrical shapes and claims to *kosmos* ("orderliness"). This correlation plays out in two passages. We have mentioned the overly expected rhythm of Hermes' second song and the narrator's accompanying commentary on its *kosmos*: "(Hermes) pronounced all things *in order*, playing the lyre under his arm" (πάντ᾽ ἐνέπων κατὰ κόσμον, ὑπωλένιον κιθαρίζων 433).[41] Long before this, though, Apollo demands that Hermes reveal the whereabouts of his cows; this demand is accompanied by threats to commit acts "*not* according to order" (οὐ κατὰ κόσμον 255), such as throwing Hermes into Tartaros (256). Thomas has noted how Apollo begins his threats with "alliteration of μ-, the monosyllables creating a pronounced sixth-foot caesura, the curt syntax … (and) explosive enjambement."[42] We can also see that

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[40] The hides which Hermes attached to the wall trigger Apollo's anger and the second song (403–417); the first song, the cows and cooked meat, and the second song are each presented as a *geras* or "honorable gift" (γέραιρε 60, νῶτα γεράσμια 122, γέρας 129, ἐγέραιρεν 429, ἐγέραιρε 432, cf. γέρας 291, 573).

[41] In his response to Apollo, Hermes himself also proclaims that the lyre "knows how to speak well and *in good order*" (καλὰ καὶ εὖ κατὰ κόσμον ἐπιστάμενος ἀγορεύειν 479).

[42] Thomas, *The Homeric Hymn to Hermes* 280.

Apollo's opening lines contain an arresting amount of un-expected metrical shapes:

ὦ παῖ, ὃς ἐν λίκνῳ **κατάκειαι, μήνυέ μοι βοῦς**
θᾶσσον· **ἐπεὶ τάχα** νῶϊ διοισόμεθ' <u>οὐ κατὰ κόσμον</u>.   255

Child, who **lies** in a crib, **confess to me about the cows**
quickly · **since soon** we shall disagree *not in good order*.

Three shapes, $_6[\cup \cup - \cup]$ (κατάκειαι), $_9[- \cup \cup -]$ (μήνυέ μοι), and
$_{2.5}[\cup - \cup \cup]$ (ἐπεὶ τάχα), are unexpected (only 0.025% of windows
of 5 shapes have 3 unexpected shapes in the Archaic corpus),
while the passage as a whole (from Λητοΐδης 253 to μητρός 267
[78 shapes]) has 7 out of 78 (3.11% of windows of 78 shapes have
7 or more unexpected shapes in the corpus).[43] The hymnist con-
centrates unexpected shapes in Apollo's speech at the same time
that Apollo threatens to act οὐ κατὰ κόσμον. In other words,
Apollo performs the breach of *kosmos* in the irregular rhythm of
his speech.

This is not the only correspondence between notions of *kosmos*
and metrical rhythm in Greek literature. Later, in the early
Hellenistic period (4th/3rd cent. BCE), the poet Simias of Rhodes
makes the association explicit in his so-called *technopaegnion* or
"picture-poem" shaped like an egg (fr.26.7–10 Powell):

Τὸ μὲν θεῶν ἐριβόας Ἑρμᾶς ἔκιξε κᾶρυξ
φῦλ' ἐς βροτῶν, ὑπὸ φίλας ἐλὼν πτέροισι ματρός,
ἄνωγε δ' ἐκ μέτρου μονοβάμονος μέγαν πάροιθ' ἀέξειν
ἀριθμὸν εἰς ἄκραν δεκάδ' ἰχνίων, <u>κόσμον νέμοντα ῥυθμῶν</u>,   10

Hermes, loud-voiced herald of the gods, took it (the egg) from
under its dear mother's wings and gave it to the world, command-
ing me to increase gradually the number of feet from the original
one foot to ten at the end, *while maintaining proper order in the rhythm*,[44]

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[43] Several of the unexpected shapes in his speech occur within the com-
parably unexpected metrical position of their words, for example κραταιῷ
("strong" 265), whose lemma is $z = -2.0$ (3/15 instances in the Archaic
corpus) at this position, and ζόφον ("dark" 257), which has an expectancy of
$z = -2.16$ (3/17) as a word in the same form and $z = -2.71$ (3/25) as a
lemma.

[44] Transl. N. Hopkinson, *Theocritus Moschus Bion* (Cambridge [Mass.] 2015)
569.

Plato, too, associates *kosmos* with *rhythmos*, perhaps indebted to the earlier musicological work of Damon (*Resp.* 400A):

βίου <u>ῥυθμοὺς</u> ἰδεῖν <u>κοσμίου</u> τε καὶ ἀνδρείου τίνες εἰσίν· οὓς ἰδόντα τὸν πόδα τῷ τοῦ τοιούτου λόγῳ ἀναγκάζειν ἕπεσθαι καὶ τὸ μέλος, ἀλλὰ μὴ λόγον ποδί τε καὶ μέλει.

(We must) see which are the *rhythms* of an *orderly* and manly life. In view of this the metrical foot and the melody must follow the verbal expression and not the expression follow the meter and the melody.[45]

Thomas suggests that the poet of the Homeric hymn may have been aware of similar associations and metaphors of ἴχνος ("tracks, feet") as related to sense (cf. Plato *Parm.* 128C) and rhythm (Simias fr.26) and fashioned the order of words in the meter to reflect the meaning of the poetry, such as when Hermes drives the cattle backward, "the front to the back and the back to the front" (τὰς πρόσθεν ὄπισθεν, / τὰς δ᾽ ὄπιθεν πρόσθεν 77–78).[46] We could add to this example the unexpected position of ³ἴχνια ("tracks, footsteps") by Apollo in 351 when describing Hermes' deceitfulness (δολοφροσύνην 361), a word that is out of place both according to its metrical shape (dactylic words are rarely in this position either in the Archaic or overall corpus, cf. Appendix) as well as its word form ($z = -2.11$, 1/9, in the Archaic corpus) and

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[45] Transl. C. Emlyn-Jones and W. Preddy, *Plato* VI (Cambridge [Mass.] 2013) 277. With reference to Damon (400B): "we shall also consult with Damon as to which rhythmical movements are appropriate to illiberality and insolence, or madness and other forms of vice, and which ones are left for their opposites," μετὰ Δάμωνος βουλευσόμεθα, τίνες τε ἀνελευθερίας καὶ ὕβρεως ἢ μανίας καὶ ἄλλης κακίας πρέπουσαι βάσεις, καὶ τίνας τοῖς ἐναντίοις λειπτέον ῥυθμούς; cf. 424C and *Laches* 200A–B. See E. Ermolaeva, "The Figure Poem *Egg* by Simias of Rhodes (*AP* 15, 27) and Metrical Terminology," *Philologia Classica* 12 (2017) 122–129, at 127, and N. A. Almazova, "Daktylus und Enhoplios in Damons Rhythmuslehre," *Hyperboreus* 22 (2016) 94–126, at 95. The musicologist Aristides Quintilianus (3rd cent. CE) likewise associates *kosmos* with *rhythmos* in musical rhythm (3.25.44–47): "therefore, a *cosmos* of matter is the motion of the elements, while a *cosmos* of the soul is the melody of the vowels. And indeed, also of *rhythms*," διὸ <u>κόσμος</u> μὲν ὕλης ἡ ἐκείνων κίνησις, <u>κόσμος</u> δὲ ψυχῆς †ἠνουσος† μελωδία. καὶ μὴν καὶ τῶν <u>ῥυθμῶν</u> (transl. adapted from T. J. Mathiesen, *Aristides Quintilianus: On Music in Three Books* [New Haven 1983] 201).

[46] Thomas, *The Homeric Hymn to Hermes* 191 (*ad* 75–78).

lemma ($z = -2.74$, 3/10, in the Archaic corpus). While it is beyond the purview of this article to argue for direct knowledge of such semantics of *kosmos* or related terms by the hymnic poet, nevertheless we now know something new. In the hymn, there is a positive correlation between *kosmos* and the expectancy of metrical shapes.

More thematic associations emerge from exceptionally rhythmic and arrhythmic passages. Hermes' overly rhythmic performances are associated with desire (ἐρατεινόν 52, ἐρατήν 153, ἐρατή 421, ἵμερος 422, ἐρατόν 423, ἐρατή 426, ἔρος 434), gifts (γέρας 60, 122, 129, 429, 432, cf. 291, 573), sleepiness (449), sweetness (γλυκύς 422), and laughter (Ζεὺς δὲ μέγ᾽ ἐξεγέλασσεν 389, γέλασσε δὲ Φοῖβος Ἀπόλλων 420). But we find more negative associations in arrhythmic passages. When Apollo threatens Hermes οὐ κατὰ κόσμον, his future deeds emphasize darkness (λαβὼν ἐς Τάρταρον, ἐς ζόφον, οὐδέ … ἐς φάος, ὑπὸ γαίῃ 256–258, cf. ἐς φάος 402) and helplessness (ἀμήχανον 257). Later, Apollo describes the theft to Zeus in perhaps the most arrhythmic passage in the hymn (343–363, 12/107 unexpected shapes [0.035% of such windows in Archaic epic]), again emphasizing darkness (κόνις … μέλαινα 345, μελαίνῃ νυκτὶ ἐοικώς 358, κατὰ ζόφον 359) and helplessness (ἀμήχανος 346; cf. ἀμήχανος 434 and μηχανῶτα 436, with Thomas *ad loc.*), as well as monstrosity (πέλωρα 342 and πέλωρ᾽ 349) and quick, skilled movement (διαπυρπαλάμησεν … τὸ μὲν ἔνθα, τὸ δ᾽ ἔνθα 357). This is not to say that these themes are intrinsically or even pervasively associated with rhythmicity in epic elsewhere, only that they are so in the hymn.

The above survey of the expectancy of metrical shapes in the *Homeric Hymn to Hermes* proceeded on two levels. A macro-scale analysis of unexpected shapes identified passages with noticeably few or exceptionally concentrated amounts of unexpected shapes. Closer inspection of these passages revealed unanticipated correlations. Both of Hermes' songs, as well as his cooking of the cows, occur in overly rhythmic passages with few unexpected shapes. Conversely, the most arrhythmic passages occur in speeches by Apollo and at times accompanied threats and other formal irregularities such as alliteration and atypical

caesurae.[47] But most surprising of the findings are the associations between rhythm and notions of *kosmos*. Descriptions of "orderly" (κατὰ κόσμον) performance had the fewest unexpected shapes, while threats of "unseemly" (οὐ κατὰ κόσμον) conflict had a concentration of unexpected shapes. Granted, there are limits to the current data and methodology. The edition of texts is paramount, and the text of *Homeric Hymn to Hermes* is rather thorny, for instance in the corruption of line 346 and resulting difference in words, word order, metrical shapes, and rhythmic data.[48] Hagel's list of appositive groups, which is the basis of the current analysis, also needs labor-intensive refining and expansion.[49] Future phonological analysis could and should have the option to incorporate larger groups, such as minor phrases and formulas, major phrases and cola; such reanalysis would provide new statistics relevant under different phonological conditions.[50] That said, this paper advances the state of the art in important ways, both in methodology and in analysis, and uncovers new potential for future investigation.

4. *Conclusion: the rhythm of metrical shapes*

The above analysis defines and defends a central claim: when metrical shapes are measured by expectancy, we can better identify the rhythm of authors, poems, characters, and passages in ways that can inform their style and interpretation. It does so by incorporating the metrical shapes of words and appositive groups and by extending previous analysis of metrical shapes

[47] These include the curious allotment of the "Bee Maidens" to Hermes at the poem's end (ἐθέλουσιν 561 through Μαιάδος 574, 9/90 [0.87% of windows]).

[48] Compare the editions of the manuscripts and Allen (αὐτὸς δ' οὗτος †ὅδ' ἐκτὸς† ἀμήχανος, οὔτ' ἄρα ποσσίν) with Evelyn-White (old Loeb)/Perseus/SEDES (αὐτὸς δ' ἐκτὸς ὁδοῦ, τις ἀμήχανος, οὔτ' ἄρα ποσσίν) and West (new Loeb) (αὐτὸς δ' οὔθ' ὁδοῦ ἐκτὸς ἀμήχανος, οὔτ' ἄρα ποσσίν).

[49] Hagel, in *Autour de la césure* 137, does not, for example, include the ἐκτός as found in line 346; future work must also clarify on a case-by-case basis whether candidates for apposition in prepositional phrases function as pre-/post-positions or are adverbial (and perhaps words in a larger appositional unit, such as the minor or major phrase).

[50] For speech rate and apposition cf. Bozzone, *Living Language* 91.

with a measure of expectancy. Such a measure allows for the more accurate and useful comparison of distribution by standard deviations, such as in locating passages that are rhythmically unusual by their density of unexpected shapes. We see its utility especially in extreme cases, such as in the uncommon density of unexpected shapes in the urban mime of Theocritus *Idyll* 15.

But it is the unforeseen correlations between themes and the rhythm of shapes in the *Homeric Hymn to Hermes* that suggest that the method and data have a more pervasive application to the study of Greek epic. By mapping rhythmic analysis to narrative, this case study reveals associations between song, *kosmos*, and other themes with the expectancy of metrical shapes. Such a methodology that combines computational exploration and closer reading could open new avenues of inquiry. Do themes have rhythmic expectations? To what extent do social, rhetorical, or affective goals condition the articulation of hexameter's inner metric? While this study is preliminary, the goal of this article is to make the method and data available for future adaptation and exploration and provide brief proofs of concept for the stylistic importance of metrical shapes. Such importance becomes visible through exploration of the data within the text in a process that brings readers closer to reconstructing the potential experience of the poems by audiences attuned to the rhythms of Greek epic.[51]

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APPENDIX

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