

SIGMATISM IN GREEK POETRY¹

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Sigma is one of the most frequently occurring consonants in ancient Greek and the least esteemed. Dionysius of Halicarnassus calls it “graceless” and “unpleasant,” (*De Comp. Verb.* 14.80).² “When used to excess,” he says, “it causes great pain.” This view, and the theory of euphony to which it belongs, dominated Greek literary criticism throughout its history and is widely believed to have influenced the actual practice of Greek poets. In the study that follows comprehensive statistics are presented that suggest the existence of such influence and the nature of its limitations.

Sigma’s unfortunate reputation was already established by the sixth century B.C. when Lasus of Hermione, who was said to be Pindar’s music teacher,³ wrote the asigmatic *Centaurs* and a *Hymn to the Demeter of Hermione*.⁴ His feat was not without imitators, as a Bodmer Papyrus amply attests with its sixty verses of a satyr play that contain not a single sigma.⁵

By the last half of the fifth century B.C. the association of excessive sigma with bad style was securely enough fixed in the popular mind that the comic poet Plato parodied Euripides’ sigmatism in his *Heortae*. Plato’s target was *Medea* 476 where Medea uses seven hissing sigmas to remind Jason of how she saved him and how his whole crew knows it:

ἔσφρά σ’ ὥς ἴσασιν Ἑλλήνων ὅσοι . . .

¹ An earlier version of this paper was read at the Annual Meeting of the American Philological Association in Boston, Dec. 30, 1979. I am grateful for the comments of those who heard it and to the anonymous referees for their helpful suggestions.

² H. Usener—L. Radermacher, *Dionysii Halicarnasei quae Extant*, vol. 6 (Stuttgart 1929; repr. 1965) 54–55.

³ *Vita Thomana* in A. B. Drachmann, *Scholia Vetera in Pindari Carmina*, vol. 1 (Leipzig 1903; repr. 1964) 4. For discussion, see G. A. Privitera, *Laso di Ermione*, *Filologia e critica* vol. 1 (Roma 1965) 31–32.

⁴ Athen. 10.455B–C = *PMG* 704, Athen. 14.624E–F = *PMG* 702. Athenaeus defends Lasus’ authorship of the *Centaurs* which was apparently in doubt. His source for the *Hymn to Demeter* was Heraclides Ponticus, frgs. 161 and 163, F. Wehrli, *Die Schule des Aristoteles*, vol. 7, second ed. (Basel 1969).

⁵ Eric G. Turner, “Papyrus Bodmer XXVIII: A Satyr-Play on the Confrontation of Heracles and Atlas,” *MH* 33 (1976) 1–23. The play may be either an original composition as early as the fifth century or as late as the Hellenistic period, or possibly a revision of some earlier work.

In Plato's version someone is saved from the sigmas of Euripides:

εὖ γέ σοι γένοιθ', ἡμᾶς ὅτι
ἔσωσας ἐκ τῶν σίγμα τῶν Εὐριπίδου (Heortae, Kock fr. 30).⁶

In the fourth century B.C., Eubulus still hoped to raise a laugh by making Euripides complain about would-be *sophoi* collecting his sigmas (*Dionysius*, Kock fr. 27),⁷ and in the twelfth century, the tradition was still alive in Eustathius, who gave Euripides the epithet *philosigmatos* (*In Il.* 1170.54–56), and contrasted the “whistling” tragedians with comic poets who avoid sigma (*In Il.* 813.46).

In 1895 Tycho Mommsen made the first quantitative study of sigma in Greek poetry with a view to evaluating the ancient tradition.⁸ Following Plato's lead, he took as his model *Medea* 476, and from it derived definitions of two types of sigmatism:

1. “True sigmatism” (*eigentlicher Sigmatismus*), or sigmatism in the narrow sense, which is the occurrence of a final syllable beginning with sigma followed by an initial syllable beginning with sigma, e.g., ἔσῳσά σ' (*Medea* 476). This kernel may be extended by adjacent syllables beginning with sigma to form groups of three or four syllables, e.g., ἐκσῳσασά σε (*IT* 1469, Mommsen 669–670).
2. “Quasi-sigmatism” (*uneigentlicher Sigmatismus*), or sigmatism in a wider sense, which is the occurrence of syllables beginning with sigma in the same word, e.g., ἴσασιν (*Medea* 476, Mommsen, 670).

Either kind may be enhanced by multiple occurrences or by other sigma syllables in the same verse. Either may be diminished by intervening punctuation, verse end, change of speaker, or elision (Mommsen, 670–672).

Mommsen counted each type in all its varieties in the texts of the three tragedians, Aristophanes and the comic fragments, thirty-three epic poets and forty-six prose works. On the basis of his calculations of total “true” sigmatism per verse, he concluded that Euripides is almost three times as sigmatic as Aeschylus and twice as sigmatic as Sophocles;⁹ and further, that Euripides' excess is apparent not only in the absolute number of occurrences, but in the number of occurrences of the more extended types (Mommsen, 673–674), and in the avoidance of techniques to weaken their force (Mommsen, 679–681).

Aristophanes was found to employ “true” sigmatism at a slightly lower rate than Sophocles, while Homer and Hesiod are much less sigmatic than

⁶ Th. Kock (ed.), *Comicorum Atticorum Fragmenta* (Leipzig 1880–1888).

⁷ R. L. Hunter, *Eubulus* (Cambridge 1983) 275.

⁸ Tycho Mommsen, *Beiträge zu der Lehre von den gr. Präpositionen* (Berlin 1895) 668–762.

⁹ Aeschylus averages one example of “true” sigmatism in every 140 verses; Sophocles, one in 122 verses; and Euripides; one in 54 (Mommsen, 673).

any of the dramatists, and the Hellenistic epic poets still less, with Aratus exhibiting the least "true" sigmatism of all.¹⁰

In 1908 J. A. Scott made another quantitative study of sigma without reference to Mommsen, and a later analysis was done by O. J. Todd in 1942 without reference to Scott or Mommsen.¹¹ Scott surveyed samples of dramatic verse in search of unusual concentrations of sigma. Like Mommsen, his standard of excessive sigmatism was *Medea* 476, but Scott considered the quantity of sigma rather than its arrangement. He easily found verses with 8, 9, and even 10 sigmas in Aeschylus, Sophocles and Aristophanes, and often in circumstances that did not justify the use of harsh sounds. These discoveries led him to conclude that there were no significant differences in the use of sigma by the three tragedians and Aristophanes, and that sigma had no emotive value per se. Todd came to the same conclusion by comparing the amount of sigma in 1900 verses of tragedy divided into nineteen samples. He found Euripides slightly more sigmatic, but was unimpressed by the difference.

The evaluation of relative sigmatism could not be settled by such casual investigation, however, and no one knew this better than Todd, who said:

I am humbly aware that a complete and final answer would involve counting all the syllables and all of the 's' sounds in the extant plays and the fragments of the various Greek tragedians; and even then we might feel scientifically uncomfortable because the thirty-three complete plays and fragments represent only a small fraction of the tragedies with which the comic playwrights were familiar.¹²

We cannot bring back the lost plays, but with the help of a computer, Todd's first requirement is no longer in the realm of the impossible, and definitive counts can now be produced to supplement Mommsen's study. Accordingly, sigma and the sigma-compounds zeta, xi and psi were counted in the extant works of the three tragedians, Aristophanes, Pindar, Lycophron and the major hexameter poets from Homer to Nicander of Colophon.¹³

¹⁰ Aristophanes averages one example of "true" sigmatism in 103 verses; Homer, one in 196; Hesiod, one in 234; Nicander, one in 265; Apollonius, one in 266; Callimachus, one in 271; and Aratus, one in 577. Theocritus, with one in 183, is more sigmatic than the other Hellenistic epic poets, and the *Homeric Hymns* (one in 93) are more sigmatic than other early epic (Mommsen, 695; 703-704).

¹¹ J. A. Scott, "Sigmatism in Greek Dramatic Poetry," *AJP* 29 (1908) 69-77, followed by "The Effect of Sigmatism as Shown in Homer," *AJP* 30 (1909) 72-77. O. J. Todd, "Sense and Sound in Classical Poetry," *CQ* 36 (1942) 29-39.

¹² Todd (above, note 11) 35.

¹³ Machine readable texts were provided by the Thesaurus Linguae Graecae for all authors except the following: The *Iliad*, text provided by David W. Packard and corrected from the TLG text; the *Odyssey*, text provided by the APA Text Repository, entered by A. Q. Morton and corrected from the TLG text by Stephen V. F. Waite; *The Homeric Hymns*, text entered by Cora Sowa and corrected by Joseph Tebben; Pindar's *Odes*, texts entered by D. L. Clayman. For the printed sources see L. Berkowitz and K. A. Squitier, *The Thesaurus Linguae Graecae Canon of*

The results, which are expressed as ratios of /s/ sounds to total phonemes,¹⁴ and displayed in Table 1, largely corroborate Mommsen. Euripides is the most sigmatic¹⁵ dramatist, and Aratus, the least sigmatic of all; iambi and lyric are more sigmatic, on the whole, than hexameters. The overall agreement stems from the simple fact that more /s/ in general is likely to produce more occurrences of any specific arrangement of /s/.

The differences between Mommsen's results and Table 1 are more interesting, in that they suggest that poets use sigma differently, irrespective of quantity. Aristophanes, who is much less sigmatic than Sophocles overall (see Table 1), uses Mommsen's "true" sigmatism at a similar rate, indicating that he arranges his /s/ for maximum effect, actually seeking opportunities for alliteration. The opposite seems to be true of the Hellenistic poets, who have more /s/ in general than Homer, Hesiod or the *Homeric Hymns* (see Table 1), but less of Mommsen's "true" sigmatism. They do not avoid /s/ per se, but make no effort to call a reader's attention to it.

In general, Table 1 shows that, based on the quantity of /s/, the works arrange themselves by genre, and within genre, by chronological period. The grouping of works in this way indicates that the use of /s/ is dictated largely by the conventions of genre. This should not be surprising, since 86%–93% of all /s/ in this study occurs in the middle or at the ends of words—i.e., most /s/ is part of the grammatical load of the language. A very large proportion of the difference in the quantity of /s/ between epic and dramatic poetry, for example, can be traced to drama's more frequent use of verbs in the future tense, active verbs in the second person singular, and second person pronouns—all forms required for dialogue.¹⁶

Greek Authors and Works, second ed. (Oxford and New York 1986). The authors on Table 1 are represented in the study by their complete extant works with the following adjustments: only continuous, unfragmented texts were included; data from the *Homeric Hymns* was taken only from the four longer hymns (2-5), and data from Callimachus, from his five hexameter *Hymns* (1-4, 6); the *Idylls* of Theocritus judged spurious by Gow, *Theocritus*, vol. 1 (Cambridge 1965) lxvi-lxxx, were eliminated.

All texts were further edited by the author to remove corrupt passages and the sentences in which they were embedded. In most cases the deletions resulted in a loss of 0–5% of the original text. Exceptions were Aeschylus, 13% loss; and Euripides, 8% loss. The total usable verses for each author were the following: Aeschylus, 7039; Apollonius Rhodius, 5545; Aratus, 1153; Aristophanes, 14,826; Callimachus, 893; Euripides, 24,030; Hesiod, 2322; Homer, 27,798; *Homeric Hymns*, 1812; Lycophron, 1474; Nicander, 1576; Pindar, 4099; Sophocles, 9969; Theocritus, 2323; 104,859 verses in total. No sampling was employed.

¹⁴ Each vowel, consonant and diphthong was counted as one phoneme except zeta, xi and psi which were counted as two. Phonemes were identified only as /s/ or non-/s/; zeta, xi and psi were considered one /s/ and one non-/s/.

¹⁵ The words "sigmatic" and "sigmatism" refer below to the use of all /s/ sounds including sigma, zeta, xi and psi.

¹⁶ These differences do not adequately explain why Aristophanes is so much less sigmatic than the tragedians. Eustathius (*In Il.* 896.53–58) says the difference results from the fact that

Traditional subject matter and vocabulary also exert important influences on phoneme distribution. The use of particles, which is highly traditional within genres, provides an interesting illustration of this phenomenon because particles are among the most commonly used words, and none of those discussed by Denniston¹⁷ has a single /s/. It would stand to reason, then, that texts with relatively more particles would have relatively less /s/. To test this hypothesis, all particles listed by Denniston were counted in the texts under study, and the ratio of particles per word calculated for each. These are listed in Table 2 in descending order, to facilitate comparison with Table 1. The similarity is striking,¹⁸ especially if one thinks in terms of genre groups rather than the precise order of texts within the groups. Only three authors fail to support the hypothesis: Aristophanes, Pindar and Theocritus all have fewer particles than predicted. These discrepancies and the more minor differences between the tables indicate that other factors besides particle quantity are involved in determining the rate of /s/.

Only a poet whose use of /s/ differs significantly¹⁹ from others writing in the same genre at the same time can be said to have a special attitude towards it. This is, in fact, the case for Euripides, who is placed directly above Sophocles and Aeschylus in Table 1, but is significantly more sigmatic,²⁰ as illustrated in Table 3, which shows the ratio of /s/ sounds to total phonemes in the works of the tragedians. It is clear that Euripides with 19 extant plays is more self-consistent in his use of /s/ and more sigmatic overall than either Sophocles or Aeschylus.²¹

comedy uses the Attic double tau in preference to the double sigma, but when double taus are counted and substituted with double sigmas, Aristophanes is still much less sigmatic (.089) than Sophocles (.097) or Aeschylus (.097).

¹⁷ J. D. Denniston, *The Greek Particles*, second ed. (Oxford 1954).

¹⁸ The Spearman Rank Correlation of sigma/phoneme and particle/word is -.7930 (sig. level = .0030), a strong, negative correlation.

¹⁹ The word "significant" refers to statistical significance based on results of the chi-square or chi-squared test; see B. Brainerd, "Statistical Analysis of Lexical Data Using Chi-squared and Related Distributions," *CHum* 9 (1975) 161-78; for an application specifically in classics, see F. P. Jones and F. E. Gray, "Hexameter Patterns, Statistical Inference and the Homeric Question: An Analysis of the La Roche Data," *TAPA* 103 (1972) 187-209.

²⁰ In a comparison of /s/ and non-/s/ phonemes in the three tragedians the chi-square is 60.056 with 2 d.f. and a probability of virtually zero that the differences could be due to chance alone. When only Sophocles and Aeschylus are compared, the differences are not significant (chi-square = .245 with 1 d.f. and prob. = .6204).

While it is true, as a general rule, that statistical and literary significance are not necessarily equivalent, in this case we can count on the perception of Plato Comicus, a contemporary of Euripides, and his audience, who laughed at the joke, to guarantee that the difference in sigmatism between Euripides and the other tragedians was both perceivable and meaningful.

²¹ A comparison of /s/ to non-/s/ phonemes in Euripides' nineteen plays yields a chi-square of 26.809 with 18 degrees of freedom and a reasonable probability (.0827) that the differences between them could be attributed to chance. Neither Sophocles nor Aeschylus are equally consistent: Sophocles' chi-square = 14.029 with 6 d.f. and prob. = .0293; Aeschylus' chi-square = 40.201 with 6 d.f. and prob. = 0.

Table 3 also reveals that the quantity of /s/ overall is not a useful indication of authorship, since there is considerable overlap in the /s/ rates of individual works of each tragedian, and problematic plays such as Euripides' *Rhesus* and *Cyclops* fall well within the limits established for their author as a whole. It is true that the *Prometheus*, whose authorship has been questioned,²² is Aeschylus' most sigmatic work, but its /s/ rate is not significantly different from that of the *Persae*,²³ whose authorship is firmly established.

The arrangement of works in Table 3 also fails to correlate with date of composition. *Oedipus Coloneus*, Sophocles' most sigmatic work, is his last (produced 401 B.C.), but it scarcely differs in /s/ rate from the *Ajax*, generally considered to be his earliest (ca. 447 B.C.).²⁴

One factor affecting the rate of /s/ in tragedy is the proportion of lyric to iambic passages, because tragic iambi are more sigmatic than tragic lyrics. This is illustrated in Table 4, where it is clear that the difference is consistent for all tragedians, including Euripides. Table 4 also reveals that Aeschylus uses /s/ at a higher rate than Sophocles in both lyrics and iambi. Their overall rate is the same in Table 1 because Aeschylus has a higher proportion of lyric passages.²⁵

An explanation for the lack of sigmas in lyrics was offered by Aristoxenus, who claimed that musicians avoided sigma because it was harshly pronounced and unsuited to the flute.²⁶ It is also well to remember that tragic lyrics differ in form and function from the iambic passages, which gives rise to a different mix of grammatical structures and vocabulary that in turn determine the proportion of /s/.

The lower proportion of sigma in lyric is a consistent and widespread phenomenon, evident not only in the different rates of /s/ in tragic lyrics and iambi, but in the high proportion of /s/ in Lycophron, who wrote iambic poetry without lyrics, and the low proportion of /s/ in Pindar, who wrote lyrics without iambi (see Table 1).

Pindar's position next to last on Table 1 is of special interest because we have a fragment of his own thought on the subject, quoted by Dionysius of Halicarnassus in his short discussion of sigma (*De Comp. Verb.* 14.80, above note 2):

τῶν γοῦν παλαιῶν τινες σπανίως ἐχρῶντο αὐτῷ καὶ
πεφυλαγμένως, εἰσὶ δὲ οἱ καὶ ἀσίγμους ὅλας ᾠδὰς
ἐποιοῦν· δηλοῖ δὲ τοῦτο καὶ Πίνδαρος ἐν οἷς φησι·

²² C. J. Herrington, *The Author of the Prometheus Bound*, (Austin 1970).

²³ Chi-square = .0228 with the Yates correction for 1 d.f., prob. = .8799.

²⁴ On the dates see C. Whitman, *Sophocles* (Cambridge, Mass. 1951) 55.

²⁵ Based on number of phonemes, Aeschylus' texts as edited for this study are 33% lyric, Sophocles', 19%, and Euripides', 20%.

²⁶ Fr. 87 Wehrli, *Die Schule des Aristoteles*, vol. 2, second ed. (Basel 1967) = Athen. 11.467A.

Πρὶν μὲν ἔρπε σχοινοτένεια τ' αἰοδὰ διθυράμβων
καὶ τὸ σάν κίβδηλον ἀνθρώποισιν ἀπὸ στομάτων,
(Snell-Maehler, fr. 70b).

Some of the ancients used it seldom and guardedly, and there were those who wrote entirely asigmatic odes. Pindar makes this clear when he says:

Formerly, reed-thin songs of dithyrambs glided
from the mouths of men and
sigma, a false-coin . . .

In 1919 an *Oxyrhynchus Papyrus* (1604) put Pindar's lines in context, making it clear that the poet meant to contrast his own dithyramb with an older style.²⁷ Given the position and force of πρὶν, these older dithyrambs must be the σχοινοτένεια αἰοδὰ characterized by σάν or sigma.²⁸ Although there has been a good deal of debate on the meaning of these lines,²⁹ the statistics on Pindar's use of /s/, which is much less than other fifth century lyricists (see Table 4), confirm Dionysius' interpretation. His linking of Pindar's dislike of sigma with Lasus' asigmatic experiments may have been the source of the tradition that Lasus was Pindar's teacher.³⁰

Table 4 shows that even Euripides is subject to the forces that limit /s/ in lyric, but it also shows that his lyrics are more sigmatic than those of the other tragedians. If we look further to see where Euripides' /s/ sounds are located, we find that 14.1% are word-initial compared to 11.5% for Aeschylus. If word-initial /s/ is discounted, there is virtually no difference between

²⁷ B. P. Grenfell and A. S. Hunt (eds.), *The Oxyrhynchus Papyrus*, vol. 13 (London 1919) 35 and 41.

²⁸ N. Terzaghi, "Per la storia del ditirambo," *AAT* 55 (1919-1920) 458.

²⁹ The confusion over this passage can be traced to Athenaeus, who quotes it several times in different contexts, stating that Pindar was accused of using too much sigma (Athen. 10.455 B-C = fr. 88 Wehrli, *Die Schule des Aristoteles*, vol. 3, second ed. [1969]), or that he was theoretically opposed to it (Athen. 10.448C-D = fr. 86 Wehrli). The conclusion may stem from his source, Clearchus. See G. A. Privitera, *Lasos di Ermione* (Roma 1965) 29-32 for an attempt to reconcile the passages. *P.Oxy.* 1604 put Pindar's lines back in their original context (see above p. 8), but did not solve the other difficulties, particularly the meaning of σχοινοτένεια. Wilamowitz (*Pindarus* [Berlin 1922] 342) took it as a reference to "schleppende, ungegliederte" diction, melody or rhythm, characteristic of the older dithyrambs to which Pindar opposed his own work, including those of Lasus. Another possibility has been suggested by L. Lawler, ("Limewood Cinesias and the Dithyrambic Dance," *TAPA* 81, (1950) 83-84), who argues that σχοινοτένεια is not a technical term of literary criticism but refers to the song's performance as a cyclic dance in which the dancers held a rope as in the old *geranos* or "snake-carrying" dance. This interpretation has the virtue of explaining the verb ἔρπε (1) as the motion of the dancers imitating a snake. No one else has given an adequate account of it. For a survey of opinion see G. A. Privitera, "L' Asigmatism di Lasos e di Pindaro in Clearcho fr. 88 Wehrli," *RCCM* 6 (1964) 164-70.

³⁰ See Privitera (1965) above note 29, p. 31. On the dangers of accepting the literal truth of pupil-teacher relationships in ancient biography see J. Fairweather, "The Biographies of Ancient Writers," *Ancient Society* 5 (1974) 262-263.

them.³¹ It is a mistake, however, to conclude from this that the rate of initial sigma accurately predicts the overall sigma-rate as a general rule, or that discounting initial sigma will bring all sigma-rates into close proximity.³² This is clear from Table 5, which lists initial /s/ per phoneme for all of the authors under study. Among the surprising findings here are the relatively high rates of initial /s/ for Aristophanes and Pindar, and the very low rate of Apollonius of Rhodes. Since word-initial /s/ ought to be the easiest for an author to manipulate, an extremely low rate such as Apollonius', and a very high rate, such as Euripides', may well have been intentional. Perhaps Eustathius was right: Euripides was *philosigmatos* (*In Il.* 1170.54–56).

Table 5 indicates further that rates of initial /s/ do not exactly mirror the chronology of the works; this is much clearer in Table 1. The irrelevance of initial /s/ to chronology and to authorship is corroborated when initial /s/ is calculated for individual tragedies. Although the *Rhesus* has Euripides' lowest rate of initial /s/ per phoneme (.012), it shares this rate with the *Phoenissae*, *Supplices*, *Hercules Furens* and *Trojan Women*, indicating that no special significance should be attached to it. Similarly, the *Prometheus* has Aeschylus' highest rate of initial /s/ (.013), but it is shared with the *Septem*.

We can observe the general effect of Euripides' sigmas by comparing the distribution of /s/ in a tragedy of Euripides and Aeschylus. In Figure 1 the densities of /s/ per verse are compared in the *Agamemnon* and the *Iphigeneia in Tauris*. For the *Agamemnon* the distribution peaks sharply at two per verse, while the distribution of the *IT* has a flat peak extending from two to three per verse and a longer tail. More /s/ in Euripides overall means more verses with moderate amounts of /s/ as well as more verses with high /s/ densities.

We would like to know whether Euripides drove up his overall /s/ rate by cramming eight, nine and ten /s/ sounds into verses to create special effects, or whether the distribution of /s/ per verse is no more than what we would expect by chance, given his high overall rate. One way to answer this question is to calculate how many verses with high concentrations of /s/

³¹ Without initial /s/ Euripides' rate is .087 for combined iambi and lyrics, Aeschylus' .086, and Sophocles' .085. The small difference remaining between Euripides and Aeschylus derives from their differing proportions of lyric and iambi. When initial /s/ is tallied separately for each and subtracted from total /s/, the result is as follows: for iambi, Eur. = .089, Aes. = .089, Soph. = .086; for lyrics, Eur. = .080, Aes. = .079, Soph. = .077. No significant differences remain between Euripides and Aeschylus (for iambi, chi-square = .1461 with the Yates Correction for 1 d.f., prob. = .7023; for lyric, chi-square = .1274 with the Yates Correction for 1 d.f., prob. = .7211). When the three tragedians are compared, non-initial /s/ is not significantly different in the lyrics (chi-square = 2.2840 with 2 d.f., prob. = .3192), but remains so in the iambi (chi-square = 12.8785 with 2 d.f., prob. = 0).

³² The Spearman Rank Correlation of total /s/ per phoneme and initial /s/ per phoneme is fairly strong (.6228, sig. level = .0198), but the correlation of total /s/ per phoneme and non-initial /s/ per phoneme is much stronger (.9642, sig. level = .0003).

exceed the number predicted by chance.³³ The results show that Euripides has a total of only twelve verses with six or more /s/ in excess of the chance prediction. Seven of these are in the *Bacchae* and none are in the *Medea*.³⁴ These numbers should be compared to those of Sophocles, who has three such verses in the *Philoctetes*, Aeschylus, who has four in the *Persae*, and Aristophanes, who has a total of nineteen, including six in the *Nubae*.³⁵ In fact, every author in the fifth century or earlier including Pindar has at least one verse with six or more /s/ in excess of the chance prediction, with the highest number occurring in the *Odyssey*.³⁶ In contrast, none of the Hellenistic authors has even one, including the most sigmatic Lycophron. We can conclude, then, that Euripides' license to occasionally create more heavily sigmatic verses than chance predicts is consistent with the practice of his predecessors and contemporaries.

Another approach to evaluating the density of /s/ per verse is to collect all of the verses with high densities of /s/ and make an individual judgment in each case about whether the poet has deliberately exploited the harshness of the /s/ sounds. This is Scott's method. Its disadvantages are that it depends on a subjective judgement of the content of each targeted verse, and it ignores all untargeted verses. Also, by counting only /s/ per verse it cannot take account of varying verse lengths. In spite of these considerations it has one great advantage in that it allows us to see how poets place /s/ in verses where it is very dense and to guess at their intention in doing so.

We can improve on Scott's results by accumulating more evidence. A list of densely sigmatic verses from the authors on Table 1 can be found in Table 6. Of 208 verses with eight or more /s/ sounds, my subjective reading indicates that fewer than half refer to circumstances unpleasant enough to justify the use of harsh sounds. There is no need to cite more than a few examples such as *Phoen.* 594–596; *Herac.* 25–27; *Hec.* 394; *Med.* 1149; or *O.T.* 425. We cannot, of course, enumerate the verses with similar contents that are not very sigmatic. Among the 104,859 verses included in this study there must be very many more than the 100 or so that are densely sigmatic.

Harshness of content is by no means the only cause of heavily sigmatic lines. Theocritus, e.g., produces a line of ten /s/ in imitation of a Doric accent,³⁷

πασάμενος ἐπίτασσε· Συρακοσίαις ἐπιτάσσεις. (*Id.* 15.90)

³³ The chance prediction was based on the Poisson distribution, which is used to predict rare events in large populations. It was first suggested for Greek phonemes by David W. Packard, "Sound Patterns in Homer," *TAPA* 104 (1974) 259 note 30. For a description of the theory and method see Brainerd (above, note 19).

³⁴ Each of the following has one such verse: *Alc.*, *Cyc.*, *Herac.*, *Phoe.*, *Tr.*

³⁵ *Av.* has 4, *Plut.*, 2; *Ra.*, 3; *Thes.*, 2; *Vesp.*, 2.

³⁶ Pindar has 2; Hesiod, 9; the *Iliad*, 10; *Odyssey*, 38.

³⁷ See A. S. F. Gow, *Theocritus*, vol. 2 (Cambridge 1965) on 15.89–95.

The eight sigmas of *Lys.* 577 are adjuncts to the seven repeated ου's that are unparalleled among the texts under study.³⁸

καὶ τοὺς γε συνισταμένους τούτους καὶ τοὺς πιλοῦντας ἑαυτοὺς

Some highly sigmatic lines seem like accidents that result from the presence of a single /s/-filled word, e.g.,

σὺ δ' ἐξελίσσεις πῶς θεοῦ θεσπίσματα; (Eurip. *Supp.* 141)

or from repetitions of double sigmas as,

τοσσοῖδ' ὅσσοισιν σὺ μετ' Ἀργείοισιν ἀνάσσεις; (*Il.* 14.94)

For the most part, /s/ sounds seem to be arranged in verses without any effort to make them noticeable or any special effect intended. This is consistent with the statistical evidence that highly sigmatic verses are not generally more numerous than chance predicts. It does not follow from this that Greek poets never intentionally packed a verse with sigmas, only that they did it very rarely and that the intent must be judged individually in each case.

To recapitulate then, overwhelming statistical evidence indicates that the proportion of /s/ in Greek poetry is determined primarily by the requirements of genre and is not a reliable test of either authorship or date. The tradition that Euripides is more sigmatic than the other tragedians is proven to be true, though his occasional use of more heavily sigmatic lines than chance would predict is not inconsistent with contemporary practice. His excess sigmas are for the most part word-initial, and could have been deliberate.

The influence of the euphonic proscription of sigma is proven in the case of only two poets, Pindar and Aratus, whose use of /s/ is significantly less than those of their contemporaries writing in the same or a closely allied genre. Pindar's own words on the subject indicate that his low /s/-rate was intentional, but it is not linked to a high level of particle use or a low rate of initial /s/, and further study will be required to determine how he achieved his goal.

On the whole, Hellenistic poets appear to be more responsive to the dictates of *euphonia* than earlier poets. This is evident in two ways: they use less of Mommsen's "true" sigmatism than earlier epic poets who have less /s/ in general, and they never have more verses with high concentrations of /s/ than chance predicts. Aratus' position as the least sigmatic of poets and Lycophron's as the most, as well as Apollonius' drastic elimination of initial /s/, indicate that they were willing to carry the rules of style to extremes.

³⁸ Av. 1122 has nine repeated /ou/s but it is not articulate speech. The next greatest concentration of /ou/ is six in three verses of Aristophanes (*Eq.* 1198, *Av.* 1170, *Plut.* 491).

On the whole, we can conclude that the ancient critical tradition expounded by Dionysius that ascribes specific aesthetic values to particular speech sounds had some limited influence in the fifth century B.C. and more general influence among the Alexandrians.

FIGURE 1

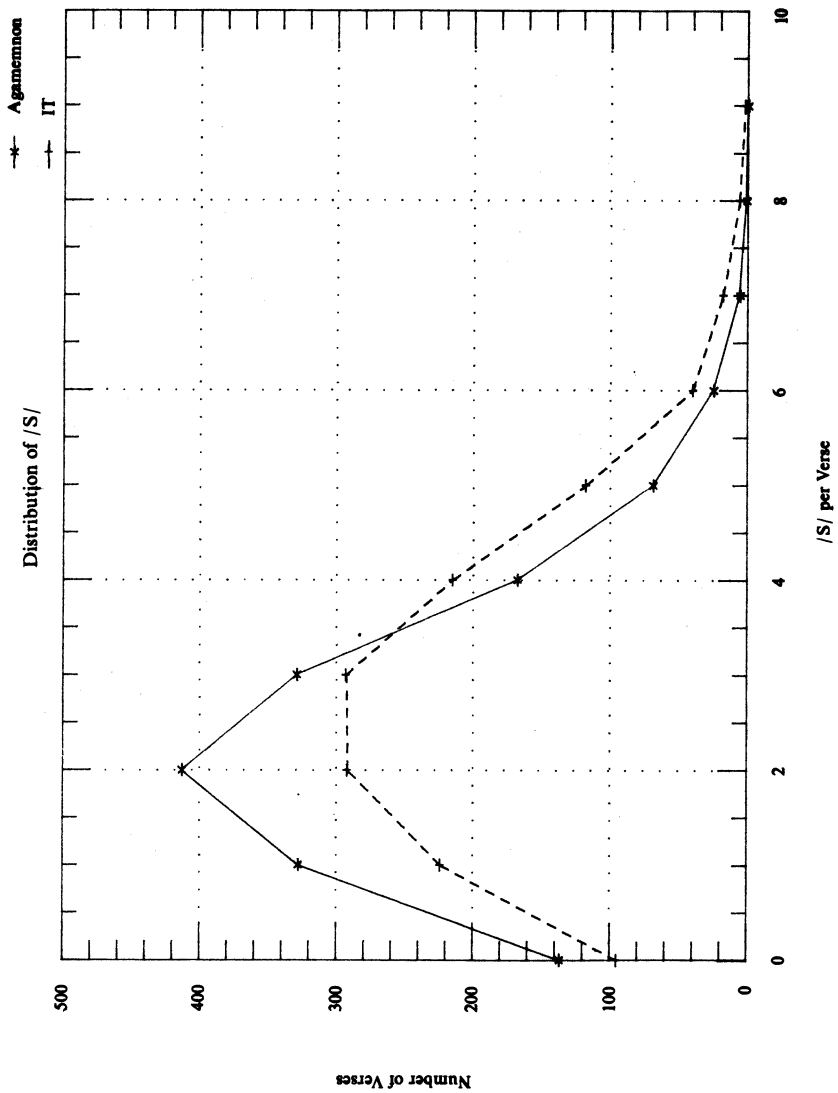


TABLE 1

Ratio of /S/ Sounds to Total Phonemes

Lycophron	.109
Euripides	.102
Sophocles	.097
Aeschylus	.097
Apollonius Rhodius	.090
Nicander	.089
Theocritus	.089
Callimachus	.088
Aristophanes	.087
Homer, <i>Odyssey</i>	.086
Homer, <i>Iliad</i>	.084
<i>Homeric Hymns</i>	.084
Hesiod	.082
Pindar	.080
Aratus	.073

TABLE 2

Ratio of Particles to Words

Authors in boxes appear outside groupings expected on the basis of Table 1.

Lycophron	.086
Euripides	.109
Sophocles	.111
Aeschylus	.114
Aristophanes	.116
Theocritus	.119
Pindar	.121
Apollonius Rhodius	.144
Callimachus	.147
Nicander	.158
<i>Homeric Hymns</i>	.163
Homer, <i>Iliad</i>	.166
Aratus	.166
Homer, <i>Odyssey</i>	.168
Hesiod	.175

TABLE 3

Ratio of /S/ Sounds to Total Phonemes
Tragedies

Ratios	Euripides	Sophocles	Aeschylus
.105	<i>IT/ Hipp.</i>		
.104	<i>Bacch.</i>		<i>Prom.</i>
.103	<i>Med. / Rh. / IA</i>		<i>Pers.</i>
.102	<i>Ion/ Supp. / Alc. / Heracl. / Hel.</i>		
.101	<i>Elec.</i>	<i>OC</i>	
.100	<i>Andr. / Cyc.</i>	<i>Ajax</i>	
.099	<i>Ores. / Hecu. / HF</i>		
.098	<i>Phoen. / Tr.</i>	<i>Elec. / Phil.</i>	
.097		<i>OT</i>	<i>Eum.</i>
.096			
.095		<i>Antig.</i>	<i>Cho.</i>
.094			<i>Supp.</i>
.093		<i>Trach.</i>	<i>Agam.</i>
.092			
.091			<i>Sept.</i>

TABLE 4

Ratio of /S/ Sounds to Total Phonemes
Tragic Lyrics and Iambi

	Lyrics	Iambi
Euripides	.092	.104
Aeschylus	.088	.101
Sophocles	.087	.100

TABLE 5

Initial Sigma per Phoneme

Authors in boxes appear outside groupings expected
on the basis of Table 1.

Euripides	.014
Lycophron	.013
Sophocles	.013
Aeschylus	.011
Aristophanes	.011
Nicander	.009
Pindar	.009
Callimachus	.008
Theocritus	.007
Aratus	.007
<i>Homeric Hymns</i>	.007
Homer, <i>Odyssey</i>	.007
Homer, <i>Iliad</i>	.006
Apollonius Rhodius	.005

TABLE 6

Verses with Eight or More /S/ Sounds

Aeschylus (9x): *Eu.* 365. (8x): *Pers.* 5, 721; *Pr.* 679.

Apollonius Rhodius (9x): *Ar.* 2.265, 3.353. (8x): *Ar.* 1.114, 1.187, 1.603, 1.789, 3.781, 3.918, 3.918, 3.1005, 3.1380, 4.246, 4.719, 4.956, 4.1048, 4.1467, 4.1725.

Aristophanes (10x): *Nu.* 367, 959; *Ra.* 1033; *V.* 557. (9x): *Av.* 467; *Ec.* 619; *Nu.* 992; *Pax* 1101; *Ra.* 1019, 1060; *V.* 400, 672. (8x): *Ach.* 634; *Av.* 299, 1279; *Eq.* 795, 1315; *Lys.* 577, 590; *Nu.* 314, 329, 331, 366, 379, 404, 434, 537, 554, 1380; *Pax* 1185, 1319; *Pl.* 223; *V.* 354, 565, 684, 752, 1221.

Callimachus (8x): *Dian.* 37; *Cer.* 68.

Euripides (10x): *Or.* 1553; *Phoe.* 594. (9x): *Ba.* 443; *Heracl.* 25, 27; *IT* 679, 765. (8x): *Alc.* 149, 241, 547, 1016; *Ba.* 611; *Cyc.* 379; *El.* 214, 807; *HF* 989; *Hec.* 394; *Hel.* 1439; *Hipp.* 943; *IA* 339, 1458; *IT* 297, 668, 1031; *Ion* 806, 1276; *Med.* 295, 405, 691, 1149; *Or.* 291, 450, 745, 1322, 1524; *Phoe.* 85, 426, 596, 600, 1089, 1211, 1309; *Rh.* 866; *Supp.* 141; *Tr.* 1023.

Hesiod (8x): *Erga* 395, 719; *Theog.* 594, 860.

Homer (10x): *Il.* 14.94. (9x): *Od.* 10.45, 13.213, 22.74; *Il.* 1.83, 10.455, 11.565, 19.141. (8x): *Od.* 1.402, 2.415, 3.98, 4.48, 4.241, 4.328, 4.501, 4.582, 4.844, 4.845, 5.269, 6.149, 7.163, 9.300, 9.324, 10.268, 10.329, 10.506, 10.528, 11.431, 14.22, 15.112, 16.82, 17.87, 17.449, 18.394, 20.92, 21.137, 21.164, 21.225, 21.409, 23.239, 24.30; *Il.* 3.63, 4.103, 4.121, 4.212, 4.235, 4.298, 4.530, 5.177, 6.65, 6.506, 8.97, 9.73, 9.508, 9.657, 10.324, 10.329, 10.467, 10.576, 13.497, 15.263, 17.283, 18.66, 19.265, 20.284, 20.495, 21.116, 23.727, 24.238, 24.387.

h. Hom. (9x): *h. Ap.* 73. (8x): *h. Ap.* 268; *h. Merc.* 106, 192; *h. Ven.* 196.

Nicander (9x): *Alex.* 366. (8x): *Alex.* 240, 540, 630.

Pindar (9x): *O.* 13.107; *P.* 8.80. (8x): *O.* 12.16.

Sophocles (10x): *OT* 425, (9x): *El.* 775; *OC* 411. (8x): *Ant.* 564; *El.* 745; *OC* 399, 1342; *OT* 1507; *Ph.* 734.

Theocritus (10x): *Id.* 15.90. (8x): *Id.* 1.112, 4.39, 7.73, 11.46, 15.65, 15.108, 16.74, 28.16.