TECHNIQUES OF READING AND TEXTUAL LAYOUT IN ANCIENT GREEK TEXTS

1. Introduction

διπλῶς ὁρῶσιν οἱ μαθόντες γράμματα

Menandri *Sententiae*, number 180 in Pernigotti (2008) 234.

This proverb, attributed to Menander in a Byzantine collection, points to the simple paradox of reading: readers are able to see both the shape of letters and the meaning conveyed by them. How does mind get from visual recognition to the recognition of meaning? The step sounds incredibly simple when we make it, but becomes exceedingly complex to explain. Strangely enough, the step is not executed in the same way for all languages and scripts.

The ability to recognise shapes must be assisted by the interpreting activity of specific parts of the brain. A famous nineteenth-century medical case tells the story of a 'French Businessman and amateur musician who woke up one day to discover that he could barely read a word'; as a consequence of a stroke, he could 'no longer read words, name colours, or read musical notes, despite having completely intact vision' (Wolf (2008) 171). Vision is thus a necessary but not sufficient requisite for reading.

Different systems of writing make use of different parts of the brain. Another case tells us yet again about a businessman 'proficient in Chinese and English' who 'suffered a severe stroke in the posterior areas. What was amazing to all at the time was that this patient, who had lost his ability to read Chinese, could still read English'.[1] In fact, people reading alphabetic scripts use some specific parts of the brain, whereas others are active when people read logographic script. In the Japanese writing system, two syllabaries (Katakana; Hiragana) as well as a large set of ideographic characters

[1] Wolf (2008) 61, with reference to Lyman, Kwan, and Chao (1938) (which I have not been able to see). We should however note that more recent and detailed studies show that the picture is more complex. In Chinese, 'most characters, including most common characters, contain a 'phonetic radical' that can show how the character is to be pronounced' (Butterworth and Yin (1991) 92). However, 'these data [collected by the authors] do not mean that readers of non-alphabetic scripts use precisely the same processes as alphabetic readers' (Butterworth and Yin (1991) 94).

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(Kanji) are used side by side, activating different parts of the brain when each of the types of characters (syllabary or ideographic signs) occurs.[2]

The present paper explores two main areas: the cognitive implication of the lack of spaces between words in ancient Greek script; the length of the line in prose texts, in musical texts, and in lyric texts (colometry). I will offer a short presentation of some basic concepts about the cognitive aspects of reading (section 1), before discussing the textual layout of papyri (sections 2–7).

The absence of space between words (*scriptio continua*) and the practice of reading aloud are often considered two factors which greatly impeded speed and accuracy for ancient readers. In fact, *scriptio continua* still occurs in some modern languages; trained readers can cope well with it, even if it does diminish the speed of reading to a certain extent. The paper will argue that ancient scribes, in laying out the page, adopted some techniques that would help readers read more quickly, and designed some books or documents for quick scanning rather than reading aloud (e.g. dictionaries; commentaries; accounts). Several pieces of evidence support the view that ancient scribes, scholars and educators considered precision and speed in reading as desirable goals, and put in place strategies that were cognitively effective to achieve these goals. Finally, a review of the evidence for silent reading versus reading aloud suggests that practices varied quite extensively. The choice was often linked to the type of texts read: silent reading was obviously suited to the quick reading of scholarly and technical texts. Finally, the colometrical layout of lyric poetry also helped in making sense of the syntax, especially for the first stanza of each poem.

Cognitive scientists have given extensive attention to reading. Direct application of the methods of cognitive science to the study of reading in antiquity is impossible because of the obvious lack of native speakers, but some key concepts from this branch of study and the use of extensive comparative evidence on modern languages gathered by cognitive scientists can help us assess this question in a new way. By studying the different types of scripts and the different writing practices it is possible to show that some choices that strike us as strange or highly inefficient were in fact effective from a cognitive point of view. The world-wide spread of Greek culture in antiquity would not have been possible if the writing system in use had been a poor one from a cognitive point of view.

[2] See Wolf (2008) 61–3. On cognitive aspects of reading Japanese see Frost (2005) 291–3, Sainio *et al.* (2007); Kajii, Nazir, and Osaka (2001) with bibliography; on Japanese script see Rogers (2005) 50–68; Coulmas (2003) 78–81 and 178–83.

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2. Cognitive aspects of reading

When we read we have to move our eyes on the page. 'We often have the impression that our eyes glide smoothly across the page as we read. However, this impression is not quite accurate: the eyes alternate between periods when they are relatively stable (called *fixations*, which typically last about 200–250 ms) and when they are moving (called *saccades*, which typically last only 20–40 ms). Vision is suppressed during the saccades'.[3] When our eyes arrive at the end of the line, they must move to the beginning of the next one, a process called a *return sweep*. 'The average saccade size in reading is about 7–8 letter spaces.', that is about 2 to 3 degrees of visual angle (Rayner, Juhasz, and Pollatsek (2005) 80). This is because acuity is optimal in the central 2 degrees of the visual field, an area called *fovea*. Parafoveal vision is markedly less good (Rayner, Juhasz, and Pollatsek (2005) 85).

2.1. *Spaces between words in ancient Greece*

Ancient Greek script does not mark word end with spaces. Some archaic inscriptions use dots (two or three) to mark the end of a word or (more often) of a word group.[4] This is not standard practice; on the other hand, the Latin practice of inserting interpuncts between words was normal in the republican and early imperial age, and lasted until the second century AD.[5]

In ancient Greece, punctuation marks, apostrophes and accents, sporadically present in papyri from the Ptolemaic era onwards, could help in locating word end. For instance, oxytone words are regularly written with grave accents on all syllables except the last one (see e.g. Kenyon (1897) xx). Accents thus helped to determine word boundaries. Help of this kind is however far from standard, and ancient readers were keenly aware of the difficulties implied by *scriptio continua* (as attested for instance by the ancient discussion on word divisions in Homer).[6]

The absence of space between words strikes us as absurd. We are even more astonished at the fact that both Greeks and Romans rejected a simple means of word separation that was in use in their tradition. Do we have evidence from the cognitive sciences about the difficulty of reading unspaced texts?

[3] Cf. Rayner, Juhasz, and Pollatsek (2005) 80.

[4] See Jeffery (1990) 50 (general) and 67 (Attica), with further references in the notes on punctuation in each geographical section on pp. 66–373.

[5] Anderson, Parsons, and Nisbet (1979) 131; see also Calabi Limentani (1991) 130–1.

[6] See e.g. Richardson (1975) 73. See also Ptol. *Judic.* 6.2 (Lammert (1961) 10, lines 11–17) and Brinkmann (1912) 620.

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2.2. Spaces between words: cognitive aspects

In 1994 Epelboim and his research associates published a controversial paper, arguing that 'removing spaces did not prevent unpracticed subjects from reading unspaced texts relatively rapidly and with meaning'.[7] More specifically, they argue that 'the main role of spaces in text is to assist word recognition, *not* to guide saccadic programming'.[8] Rayner and Pollatsek (1996) and Rayner, Fischer, and Pollatsek (1998) replied arguing that in fact spaces help both in word recognition and in guiding eye movements. However, in the words of Sainio *et al.* (2007) 2576, 'when spaces were available, the initial fixation location, referred to as the *preferred viewing location* [. . .], was close to the word centre, whereas in the unspaced text PVL shifted to the word beginning. Even though the removal of spaces had a significant influence on the PVL, it is noteworthy that a word-based pattern was preserved also for words not separated from each other by spaces. As the word center is the most optimal [sic] site for word processing [. . .] removing spaces results in a less optimal landing position leading to a longer gaze duration and more refixations on a word (Rayner *et al.*, 1998).'

Sainio was able to find similar results for Japanese script. Adding spaces facilitates reading of the Japanese Hiragana syllabary. The landing position in unspaced Hiragana is word initial,[9] but it moves towards the centre of words in spaced Hiragana. The speed of reading is however increased by 12%: a much smaller percentage than with English (30% to 50% faster with spaces). The obvious explanation is that Japanese readers are used to unspaced script (Sainio *et al.* (2007) 2582). Spacing has no effect on the combination of logographic and syllabic script (Kanji + Hiragana + Katakana), which is usual in Japanese script: readers are able to recognise the visually distinctive Kanji signs as markers of word beginning. Spaces do not seem to be beneficial in a logographic script such as Chinese.[10]

The Thai language provides a very interesting test case.[11] The Thai script is an alphabet, but spaces are used only to delimit sentences. Kohsom and Gobet (1997) have added spaces to Thai texts, and asked native speakers to read both spaced and unspaced texts. They found that reading was 'faster' with spaced texts, and concluded that 'spaces seem then to be a cue that is universal across languages' (they presumably meant 'alphabetic languages'). However, we should note that the increase in the speed

[7] Epelboim, Booth, and Steinman (1996) 466; see Epelboim, Booth, and Steinman (1994).
[8] Epelboim, Booth, and Steinman (1996) 466.
[9] Sainio *et al.* (2007) 2582 and the bibliography they cite
[10] Sainio *et al.* (2007) 2576. On Chinese script see also Wang, Inhoff, and Chen (1999); Valeri (2001) 75–88; Coulmas (2003) 50–9; Rogers (2005) 20–47.
[11] On Thai script see also Valeri (2001) 147–51; Coulmas (2003) 145–8; Rogers (2005) 221.

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of reading is minimal (about 3%).[12] The authors call this 'marginally significant'. The effects on unspaced English are much more dramatic, both for native and non-native speakers.[13] We should note that Kohsom and Gobet did not time silent reading (with comprehension tests). There is one important addition: 'subjects' retrospective reports indicate that, if anything, they thought that spaces were making reading harder' (Kohsom and Gobet (1997) 391).

Interestingly, languages such as German and Dutch make very frequent use of compound words, not separated by spaces. Compare for instance *data protection expert* with *Datenschutzexperte*. Inhoff, Radach, and Heller (2000) have studied what happens if we add spaces between the elements of compound words in German. They found that spaces 'assisted the accessing of constituent word forms during the initial phase of compound reading but hampered the subsequent specification of a conceptually unified compound meaning' (Inhoff, Radach, and Heller (2000) 23). In short: people could read individual words, but did not understand the general meaning. This shows that different strategies apply in similar conditions, and that readers used to the lack of spaces do not automatically adapt to their introduction. This confirms what Epelboim, Booth, and Steinman (1994) reported about a Dutch native speaker, whose reading speed was not significantly affected by the removal of spaces in English.

2.3. *Spaces between words: Saenger and Medieval Latin*

The palaeographer Paul Saenger wrote a book-long discussion of the introduction of 'space between words' in Medieval Latin texts, arguing two main points:

(a) *scriptura continua* made people read slowly, and was suitable for reading aloud
(b) word separation was gradually introduced in the Middle Ages and dominated in eleventh-century manuscripts. This made reading faster, which was appreciated in philosophical circles.

Saenger (1997) offers an excellent palaeographical study, documenting the diffusion of word separation throughout medieval Europe.[14] He connects this scribal habit with

[12] Sainio *et al.* (2007) 2576.

[13] 55% in non-native speakers according to data collected by Kohsom and Gobet (1997) 393; 30% to 50% according to Rayner, Fischer, and Pollatsek (1998) 1129; 18% to 52% according to Epelboim, Booth, and Steinman (1994).

[14] Saenger relies on 'word shape' (also known as 'Bouma shape': Saenger (1997) 19) as being a central feature for word recognition, a claim that is not recognised as valid by modern cognitive scientists (Larson (2004)). In any case, the 'Bouma shape' concept does not apply to most ancient Greek texts, as many calligraphic styles attested in papyri follow a bilinear standard. Even when they do not, only few letters reach below or above the bilinear limit. For a survey of writing styles see Cavallo (2008).

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the reading practices of the medieval intellectual elite, and in particular with scholastic philosophy. Word separation was determined by the need to acquire a great amount of information in a short time, scanning a text or reading it very quickly. Another factor which made medieval reading faster was the adoption of a fixed word order (Subject Verb Object) in Medieval Latin. People could read faster since they were able to anticipate what sort of words they were likely to find in the next section of the sentence.

Saenger rules out silent reading in antiquity, and assumes a correlation between reading habits and intellectual development:

> 'Stated summarily, the ancient world did not possess the desire, characteristic of the modern age, to make reading easier and swifter because the advantages that modern readers perceive as accruing from ease of reading were seldom viewed as advantages by the ancients. These include the effective retrieval of information in reference consultation, the ability to read with minimum difficulty a great many technical, logical, and scientific texts, and the greater diffusion of literacy through all social strata of the population' (Saenger (1997) 11).

Most of this is unconvincing, and is based on generalisations.[15] Under the Roman empire, Greek scholars created large reference works. More than that: we still have several major scientific treatises (on mathematics, music, medicine, etc.), and commentaries on them.[16] Commentaries on literary and philosophical texts had to be consulted along with the original text, and had to be easily accessible. We also see that the ancients developed a reference system that, even if rarely alluded to in our sources, must have been of great help (see below, section 4).

3. *The layout of Greek papyri: Johnson*

Johnson has objected to Saenger, pointing out that there is a cognitive reason for the normal layout of Greek prose texts from the Imperial age. In Greek books

[15] Saenger is even more extreme than Balogh (1927), a classic statement of the case for reading aloud as the standard practice. Balogh (1927) 89–91 admitted that silent reading was practised in antiquity under special circumstances.

[16] On science see e.g. the surveys in Brunschwig and Lloyd (2005) and Santini, Mastrorosa, and Zumbo (2002); on scholia and commentaries see Dickey (2007) 17–71, with bibliography.

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> '[t]he width of the column was such that the whole line could be taken in by the parafoveal vision, and approximated the amount of text typically read by the eye ahead of the voice. The result was that the line beginnings themselves provided natural points for the ocular fixation, and the 'decoding' of the letters could proceed regularly on a line-by-line basis' (Johnson (2000a) 611).

Johnson notes that most ancient literary rolls had 15 to 25 characters to a line (we will discuss this below).[17] The eye–voice span, that is the number of letters we read ahead mentally while reading aloud, is 15 to 20 characters. The foveal vision focuses on an area of 7 to 8 characters. The parafoveal vision embraces 15 to 20 characters. Johnson is thus able to note that there was a cognitive reason for the narrow shape of columns in papyri. There are three problems with this view: (1) this observation still links the lack of spaces to the practice of reading aloud; (2) the columns may be much wider than 25 characters; (3) parafoveal vision is marginal in the process of vision.

To address the last problem first, we should remember that '[t]he purpose of eye movements in reading is to place the to-be-processed text in the fovea, where it can be most easily identified' (Rayner, Juhasz, and Pollatsek (2005) 85). Parafoveal vision has a marginal importance in recognising words. However, narrow columns help the reader: the text is parsed into small units. This is the technique adopted in modern newspapers. Four fixations are enough to read a line in a newspaper. Moreover, narrow columns require a small 'return sweep' to the beginning of the following line. The Italian newspaper *La Repubblica* has 32 characters to a line, including spaces, just like the British *Independent*. It is not by chance that the classy *TLS* has about 42 characters to a line, beating the *New York Review of Books*, which stops at 38.

Johnson (2000a) also successfully demonstrates that the practice of reading aloud to a small group was widespread in the Greek and Roman elites in the late Roman Republic and during the Empire. He does not deny the practice of silent reading, but points out that even Pliny the Elder, an avid reader also of technical books, relied on slaves who read aloud to him (even when he was taking a bath), and does not mention silent reading (see Plin. *Ep.* 3.5; Johnson (2000a) 605). Johnson therefore concludes that 'Greek prose literary texts were, as it happens, typically read aloud' (Johnson (2000a) 612). *Literary* prose texts were not viewed as 'repositories of information [. . .] but rather as vehicles for performative reading in high social contexts' (Johnson (2000a) 616).

[17] For some figures see also Kenyon (1951) 58–9 (a small sample): he lists papyrus lines ranging from 14 to 33 letters, and takes 18 to 25 letters to a line as the normal figure

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4. Stichometry

The case for Johnson's argument can be strengthened with one further point. We can note that the format Johnson is talking about (15 to 25 letters to a line) was adopted at some point, abandoning a different and widespread format: a format that was wider and less effective from a cognitive point of view. However, I would like to suggest that the new, narrower format was not adopted solely to make reading aloud possible, but was also used to facilitate silent reading.

The additional piece of evidence comes from *stichometry*. Several subscriptions in Medieval Greek manuscripts tell us the length of literary works, measured in *stichoi*. This happens with *prose* texts, such as Herodotus, Demosthenes, or Galen. Stichometry was a current practice of ancient scribes, and, among other things, served for calculating the price of a book (see e.g. Birt (1882) 208).

Several studies collect and discuss the evidence on stichometry.[18] The results are quite consistent, attesting an average length of about 34 to 38 letters per *stichos*.[19] This is more or less the length of a hexameter. Diels suggested that scribes counted syllables rather than letters; this gives an average of 15 or 16 syllables per *stichos*.[20] If indeed that was the case, the similarity with the hexameter is heightened.

Herculaneum papyri give important additional evidence for the adoption of this practice in measuring texts written well after the heyday of Alexandrian scholarship.[21] The columns of Philodemus' *De pietate* have an average of 13 or 14 letters to a line. 'The lines of *De pietate* are regarded as half the length of a hexameter; stichometric letters thus appear every 200 lines (= 100 standard, hexameter-length lines)' (Obbink (1996) 63 n. 1). Other scribes used an 18-to-19-letter line: in that case, since the line exceeded half a hexameter, the 100-*stichoi* mark was put every 180 lines. As is apparent, this is a very coherent standard, applied to texts written in very different places and times. It was considered so important that the sums at the end of books were copied until Byzantine times, centuries after scribes had stopped numbering *stichoi* in the margins. What was the origin?

[18] See in particular Graux (1878); Diels (1882); Birt (1882), esp. 157–222 and 307–41; Harris (1883); Ohly (1928); Lang (1999). All these works give references to ancient documents and list extensive modern bibliography.

[19] Birt (1882) 197; Lang (1999) 42 with references.

[20] Diels (1882); Lang (1999) 42–3 with references; Janko (2000) 115.

[21] See Obbink (1996) 62–73 and Janko (2000) 114–18. See also Cavallo (1983) 20–1. Cavallo notes that papyri often report stichometric totals from their models. Obbink notes that '[i]n papyri of Egyptian provenance, stichometric notations are rare in prose texts (perhaps an Athenian rather than an Alexandrian convention?)' (Obbink (1996) 63 n.1). This conclusion is based also on the numbering systems used: see Parsons (2003) 1443.

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The Derveni Papyrus, probably the oldest Greek papyrus, has lines in the range of 30 to 45 letters. This is what one of the editors has to say about line width:

> 'Quite large for a prose text, it is determined by the length of the quoted hexameters which take up only one line each' (Kouremenos in Kouremenos, Parássoglu, and Tsantsanoglou (2006) 8).

The 'hexameter' *stichos* must have been a standard measure in early books (especially in the fourth century).[22] The system was taken up in Alexandrian editions (Ohly (1928) 85), and transmitted from them through Roman times to Medieval Greek manuscripts. It is of course likely that the 'hexameter' standard remained in use because of the cultural and educational importance of the hexameter. It is however striking that the first books adopted that format also for prose texts.

The power and the authority of tradition was such that, even at a time when most books had considerably narrower columns, writing was measured in *stichoi*. Johnson has offered the only systematic attempt to assess column measures in Greek papyri. He examined a sample of about 400 papyri.[23] His findings confirm that the number of letters oscillated between 11 and 26 (especially between 16 and 21); he finds only one example above 39 lines (Johnson (2004) 114–15). What does this mean? It means that the 'standard' found in the appreciably large sample of papyri written under the Roman Empire is representative of a turn in scribal habits: the long lines attested by the stichometric tradition, and by the Derveni Papyrus, were abandoned in favour of shorter ones. Note that Ptolemaic papyri too have narrow columns (Johnson (2004) 119). In conclusion, Johnson's point about the correlation between line length and reading technique is confirmed by what we know about the changes in writing patterns implied by stichometry. The reason for the change to narrow columns must have been that the format was considered 'better'; better for scribes but, above all, for readers.

Better for what? A passage by Dionysius of Halicarnassus makes clear that speed and accuracy of reading were important goals of ancient education. In his work *On literary composition* Dionysius explains that, in school, pupils are first taught the names of the letters, their values, then the syllables and so on. After that 'we begin to write and read, syllable by syllable, and slowly at first. It is only when a considerable lapse of time has implanted firmly in our minds the forms of the words that we execute them with the utmost ease [ἀπὸ τοῦ ῥᾴστου], and we read through any book that is given

[22] See also Theopomp. Hist., *FGrHist* 115 F 25 and e.g. Graux (1878) 97 and Harris (1883) 135–6.
[23] Johnson (2004) 9 studies 317 papyri from Oxyrhynchus and 96 from other sites in Egypt.

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to us unfalteringly and with incredible confidence and speed [ἀπταίστως διερχόμεθα ἔξει τε καὶ τάχει ἀπίστῳ]'.[24]

5. *Reading philosophy*

Gavrilov (1997) and Burnyeat (1997) argued against the *communis opinio*, claiming that silent reading was often practised in antiquity. Burnyeat drew attention to an important statement by the scientist Claudius Ptolemy (second century AD—a contemporary of most of the Oxyrhynchus Papyri). 'Internal *logos*' is often better than 'uttered *logos*':

> διόπερ ἔν τε ταῖς ἠρεμίαις καὶ ταῖς ἡσυχίαις μᾶλλον εὑρίσκομεν τὰ ζητούμενα καὶ κατὰ τὰς ἀναγνώσεις αὐτάς, ἂν σφόδρα τισὶν ἐπιστήσωμεν, ἡσυχίαν ἄγομεν (Ptol. *Judic.* 5.2 (see Lammert (1961) 8, lines 17–20):
>
> 'that is why it tends to be in states of peace and quiet that we discover the objects of our inquiry, and why *we keep quiet when engaged in the readings themselves* [sc. the readings required for research?] *if we are concentrating hard on the texts before us*' (translation Burnyeat (1997) 74, with Burnyeat's comments and italics)

Burnyeat comments that 'Ptolemy in the second century A.D. testifies [. . .] that they [= ancient readers] often did read silently, for the mundane reason that voicing the words is a distraction to thought' (Burnyeat (1997) 75). He adds another important passage by Plotinus (1.4.10) where the author claims that 'a reader is not necessarily aware that they are reading, least of all when they are really concentrating (μετὰ τοῦ συντόνου)' (translation Armstrong, adapted by Burnyeat). This is consistent with what Augustine says of Ambrose in a famous passage of the *Confessions*. Ambrose was reading silently, and Augustine stresses that he was 'so engrossed in study' (*tam intento*) (August. *Conf.* 6.3). Burnyeat quoted these passages to show that silent reading was common practice, or even default practice. In fact, these passages form a consistent picture. Ptolemy stresses that silent reading is a preferred option for intense study. Augustine and Plotinus concur: their

[24] D. H. *Comp.* 135.7–12 ed. Usener and Radermacher (1899), translation Usher (1985) 229, adapted. Usener and Radermacher (1899) 135, line 12, deleted ἀπίστῳ, retained by Usher (1985) 229 and by Aujac and Lebel (1981) 187, line 11. One could consider reading ἀπταίστῳ (Usener and Radermacher) διερχόμεθα ἔξει {τε} καὶ τάχει ἀπίστῳ, 'with unfaltering skill and incredible speed'. On literacy in antiquity see Harris (1989); Del Corso (2005).

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language is strikingly similar (*intento*; μετὰ τοῦ συντόνου). *Intense* application requires silent reading.[25] Augustine adds the suggestion that Ambrose preferred silent reading because he did not want to be distracted by questions, which would prevent him from 'reading as many books as he wished'. 'Concentration' might refer to reading a complex text slowly, but speed of reading is also part of the picture.

Let us examine P. Berol. inv. 9782, a commentary on Plato's *Theaetetus* written in the second century AD.[26] We have narrow columns (15 letters), and clearly marked quotations of the original text. This is clearly the sort of book that philosophers had in mind: and it is a book that is designed to help with easy reference. This is the sort of book which has escaped the attention of Johnson (2004). Johnson studies only fragments of extant works, which allow secure reconstruction of column width. Ancient commentaries were not transcribed as such in Medieval Greek manuscripts, but were excerpted for *scholia*. They are excluded from Johnson's analysis and we do not have comprehensive data on them.[27]

This matches what we know about stichometry. As it happens, some ancient writers decided to make use of stichometric signs to give somewhat precise references in quoting other books: 'around *stichos* 200', or 'ten *stichoi* above'. The references occur in Diogenes Laertius (7.33, citing Plato's *Republic*, 7.187 and 188, citing Chrysippus), Asconius (commenting on Cicero), Galen, Dionysius of Halicarnassus, and Jerome.[28] We have philosophers, doctors and commentators. Just the company we would expect.

Commentaries and scientific works are not the only kind of reference texts designed to be 'scanned'. A look at P. Oxy. 3329, a fragment of a Greek lexicon, will convince viewers that the dictionary was organised by giving prominence to the lemmata, listed in 'alphabetical' order; the definition is indented (see Haslam (1980)). The fragment probably comes from the lexicon of Diogenianus, later taken up by Hesychius.

Medical texts have a similar layout: see those published in Adorno *et al.* (2008), especially 77–82 (P. Ant. 28, Hippocrates, *Aphorismi*, with 'subject headings').

Anyone who has looked at the Zenon archives (dating from the third century BC) knows that the ancients not only did read documents for content, but also organised the layout of the page in order to make contents easily accessible. Those who had power over the scribe did not want to waste time.[29]

[25] See also Busch (2002) 37–40; Brinkmann (1912) 620 n. 1. For discussions and translations of the treatise, see Manuli (1980) esp. 78; Long (1989); Long *et al.* (1989), esp. 191.

[26] Possibly even earlier: Dickey (2007) 49. For a recent edition see Bastianini and Sedley (1995).

[27] See the philosophical commentaries assembled in Adorno *et al.* (1995). Other commentaries, to be sure, adopt larger formats: see e.g. Didymos' commentary on Demosthenes (second or third century AD) (P. Berol. 9780; see Harding (2006) with bibliography).

[28] See Lang (1999) 44 with references.

[29] See Pestman (1981) for a survey and Clarysse and Tait (1982) for a clear example (a list of landholders, with figures).

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In conclusion, it is clear that several types of ancient written documents were designed for 'fast reading' or 'scanning', and assume the ability to read quickly and silently. You will never find the word you are looking for if you read a dictionary aloud.

On the other hand, the sources quoted by Burnyeat do not support the idea of silent reading as the default practice, but stress that it is linked to 'intensive study' of serious texts. Silent reading was indeed common, also for non-technical texts, especially when confidentiality or modesty were important,[30] but we cannot be sure what was the 'default' practice, if there was one.

Burnyeat, quoting Knox (1968) and Clark (1931), states that a passage of Cicero is 'definite proof that lyric poems were read silently in the first century B.C.' (Burnyeat (1997) 74). Cicero in fact is claiming that deafness is not a great burden. Some object that *citharoedi*, 'singers', are pleasurable to listen to. In contrast, Cicero claims that deaf people are spared unpleasant sounds; that people were happy before professional singing was invented, and finally that one can have a much greater pleasure from reading the poems than from hearing them sung (Cic. *Tusc.* 5.116). This is on the lines of Aristotle's famous statement about the pleasure of reading tragedy (as opposed to watching a performance: Arist. *Po.* 1462a 12–13). It simply implies that normal readers (not to mention deaf ones) were unable to sing like professionals, and that reading a poem gives the great pleasure of subtle literary appreciation, as opposed to being swayed by the music. We can compare another passage by Cicero, from the *Orator*. Cicero claims that some metres are difficult to understand if one does not have the music. This is especially the case, Cicero says, with Greek lyric poems. It also applies to archaic Latin stage poetry. Without music, what is left but 'bare prose', *nuda oratio* (Cic. *Orat.* 183).[31] Cicero again opposes *singing* (especially in professional theatrical

[30] See esp. E. *Hipp.* 855–85 (Theseus does not reveal the content of Phaedra's letter while he reads it but only after some internal debate: see 882–4). See also the evidence discussed by Balogh (1927) 89–91 and Busch (2002) 11 n. 26 (Hor. *Sat.* 2.5.68 *tacitus leget*; Suet. *Aug.* 39; Suet. *Ner.* 15.1 *tacitus ac secreto legens*). Cyril of Jerusalem (fourth century AD), *Procatechesis* 14, discussed by Slusser (1992), recommends that a 'group of young women' (σύλλογος . . . παρθενικός) should pray by 'reading silently' (ἀναγιγνώσκων ἡσυχῇ) in church.

[31] On this passage see Prauscello (2006) 59–63, with bibliography. Lomiento (2007), in an attempt to rebut the arguments of Prauscello, speculates that Cicero 'seems to have the same phenomenon in mind' as that described by D. H. *Comp.* 122.13–143.5 ed. Usener and Radermacher (1899) (who, among other things, set out a lyric text as prose). The passages are indeed comparable (see Kroll (1913) 161), but Dionysius, unlike Cicero, does not speak of musical performances, and Cicero, unlike Dionysius, does not discuss lyric texts *written* as prose. The fact that Cicero was unable to understand some Greek and especially Latin metres without the help of music does not give us evidence on the alleged use of 'original' musical scores by Alexandrian scholars when they reconstructed the colometry of Greek lyric poetry, as claimed by Gentili and Lomiento (2001) 10–11 and Gentili and Lomiento (2003) 10.

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performances accompanied by the *tibicen*) and its absence. The passage in the *Tusculanae* is paradoxical,[32] and does not indicate how frequent the practice of *silent* reading was. It does not rule it out but it does not prove it was the norm.

6. *Musical scores*

There is another type of book where format has a cognitive impact: musical scores. Several scholars have noted that musical scores tend to be written on very wide columns (Johnson (2000b) 66–8 with data and references). Johnson discusses the cognitive reason for the format, suggesting that

> 'a musician trying to read the musical text in order to perform the music might feel a strong need to scan ahead extensively, more so than a lector trying to read aloud the words of a sentence' (Johnson (2000b) 68).

This is surprising. Johnson had argued that a 15-letter line was just the perfect format for human cognitive capacities. Why should now a longer line be better? If a singer 'scanned ahead' extensively, this would interfere with the performance, as anyone who has played from a score knows.[33] The explanation is probably simpler. Musicians were especially concerned with the notes, not the letters of the text. There are normally fewer notes than syllables, and many more letters than notes, in a single line. Notes (which resemble letters) are written at a distance one from the other. A musician would read about as many notes in a musical line as a lector would read letters in a poetic line.

In the best-preserved part of the musical *Orestes* papyrus, we have 72 letters against 31 notes (one note every 2.3 letters): this explains why columns in musical texts are more than twice as wide as a normal column.[34] In the choral piece reported in P. Berol. 6870 (second–third century AD) (Pöhlmann and West (2001) 56–60, number 17 in the collection) we find a similar ratio: one note every 1.73 letters (47 notes / 84 letters), in

[32] The paragraph that follows discusses the condition of a person who is in extreme pain, in addition to being both blind and deaf. Cicero recommends suicide.

[33] Scientists have tried to study the cognitive mechanisms that take place when a person performs from a score, but the complexities of the task are such that only the study of the simplest rhythms is possible: Kinsler and Carpenter (1995).

[34] I have examined the first six lines of P. Vienna G 2315 (the text of line 7 is fragmentary and disputed). These first 6 lines include also 9 signs of disputed meaning (probably rhythmical signs, written on the same level as the words of the text). See Pöhlmann and West (2001) 12–17 and Prauscello (2006) 123–60 for a thorough discussion.

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four lines of text.[35] The first musical line of a recently published musical papyrus has 30 letters of text for 13 musical notes.[36]

There is another advantage in wider columns. Musicians who practise in front of a wide text do not need to move to another column for quite a while; moreover, they do not have to move their eyes from the bottom of a column to the top. A large format also leaves the performers free from the need of using their hands to unroll the papyrus. This is a great advantage if the singer is also playing a stringed instrument. The larger 'leading', or 'distance between lines', and the distinctive shape given by the uneven distribution of notes, helped them not to lose their way in the large format. Finally, a large score will supply the musician with a visual image of distinctive shape, easy to recall when performing. The performer needed to memorise a single 'sheet' of music, rather than a row of columns.

7. Colometry of lyric texts

Willett (2002) has argued (following Kopff and Fleming) that Hellenistic colometry reproduced the original music and performance practice, with pauses between cola. Gentili approved this view, suggesting some corrections in the details.[37] What concerns us here is the fact that Willett argued that there was a cognitive limit to the number of syllables per colon.[38] He refers to the 'magic number' 7 +/- 2. Human memory is able to remember 5 to 9 'chunks' (words, digits, etc.) after a single hearing (or reading). Longer lists of numbers or words are not generally remembered correctly, and people need rehearsing to learn them. Willett cites relevant studies by cognitive scientists demonstrating this claim (Willett (2002) 8–11).

He argues that the long metrical periods designated in modern editions are wrong:

> 'in tragic choruses, Pindar and Bacchylides, we commonly meet periods two to six times longer—occasionally even lengthier—than anything we might predict from the rough 2-second capacity of the phonological loop or the four chunks of reliable short-term memory [. . .] if we restrict

[35] In the preserved section we find 11 musical notes to a line in lines 16, 18 and 19 (14 notes on line 17), against respectively 23, 22, 21, 18 letters to a line in the preserved part of choral lyric.

[36] See Bélis (2004) and especially West (2007) for the text and the date of the music.

[37] Gentili (2002); Gentili and Lomiento (2003) 11–12.

[38] We can add that the ancient scholars defined the maximum length of a metrical 'verse' or *stichos* at 32 short syllables (Heph. *Enchiridion* 42.16; Pace (2002) 28–9). This is derived from the length of anapaestic tetrameters, the longest stichic verse.

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> significant pauses to period-end, as the conventional colometry maintains, then individual cola could not consistently fit unit by unit into working memory for sequential processing and *comprehension*' (Willett (2002) 11–12) (emphasis added).

There is one basic problem. Willett's point is based on an equivocation of what a metrical analysis does. Modern scholars have repeatedly made clear that they are able to indicate with certainty only the points where a metrical pause is mandatory; there might be other points where metrical pauses occurred, but we are not able to find them with certainty.

However, even if we make allowances for this, the problem remains: the metrical 'periods', separated by metrical pauses, are longer than 'cola'. Willett discusses synapheia, the lack of metrical pause between cola:

> 'the whole rationale of synapheia is to weld several cola into a period by ignoring word-break or syntax, that is, to blur word and syntactical boundaries. Imagine the result of an actual attempt to perform synapheia: it would contravene the purpose of working memory, which is to process sentence segments millisecond by millisecond in real time, carrying forward sections of syntax with their associated semantic connotations to the end of sentence and the completion of meaning' (Willett (2002) 12).

In short, Greek lyric poems, as reconstructed in modern metrical analyses, could not be learned by the performers. If the poems could be learned, they could not be performed. If they could be performed, metre and music could not be perceived. And even if metre and music could be perceived, the meaning of the text could not be understood. Willett goes on to say that 'working memory . . . governs all perception and production of language' (Willett (2002) 11).

Willett's point amounts to claiming that human cognitive skills are not sufficient to read or understand a longish sentence by Demosthenes, Cicero or Proust. Of course it is not just short-term memory that comes into play. We are not able to recite a half-page-long sentence if we hear it just once. That is what short-term memory does with short sentences. However, we are definitely able to understand long sentences, and we do remember the content of a long speech.

Ancient performers obviously relied on long-term memory (not on 'working memory') to remember words, music, and (where appropriate) dance steps. In antiquity (just like today) people learned to perform by rehearsing—the very process that transforms short-term memory into long-term memory. Audiences were able to

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understand long and complex sentences; syntactic cola helped listeners break long sentences into smaller meaningful units.

Willett's point does not hold also because we are often forced to admit a clash between metrical cola and syntactical units. A clear example of this is Bacchylides 2:[39]

Ἄ[ϊξον, ὦ] σεμνοδότειρα Φήμα,	ia cho ba ||
ἐς Κ[έον ἱ]ερᾶν, χαριτώ-	2cho
νυμ[ον] φέρουσ' ἀγγελίαν,	ia cho
ὅτι μ[ά]χας θρασύχειρ<ος> Ἀρ-	glyc
γεῖο[ς ἄ]ρατο νίκαν,	pher |||
καλῶν δ' ἀνέμνασεν ὅσ' ἐν κλε[εν]νῷ	ia cho ba ||
αὐχένι Ἰσθμοῦ ζαθέαν	2cho
λιπόντες Εὐξαντίδα νᾶ-	ia cho
σον ἐπεδείξαμεν ἑβδομή-	glyc
κοντα [σὺ]ν στεφάνοισιν.	pher |||
Καλεῖ δὲ Μοῦσ' αὐθιγενὴς	ia cho
γλυκεῖαν αὐλῶν καναχάν,	ia cho
γεραίρουσ' ἐπινικίοις	glyc
Πανθείδα φίλον υἱόν.	pher |||

A single sentence covers both strophe and antistrophe, for a total of 86 syllables. This contradicts the claims that long syntactical units are not performable or perceivable. In strophe and antistrophe, word division clashes with cola divisions. In epode, syntactic cola and metrical cola are coherent. This disproves Willett's claim that cola divisions must agree with syntactic divisions. In the epode, the poet repeats the metrical structure of the last three cola of strophe and antistrophe. In strophe and antistrophe syntactic structure and word length exceed the metrical structures; in the epode, we find perfect agreement. Bacchylides sought after an 'ending' effect, offering a variation on the clash between word pattern and metrical structure that he created in strophe and antistrophe.

Willett's interpretation of colometry should be abandoned. However, it is obvious that cola division was designed with an eye to the cognitive limitation of the human mind: but for the human mind of readers, not that of the members of a chorus: '[t]hese are texts for scholars and readers, not for actors and musicians' (Parker (2001) 52).

[39] Text and metrical interpretation from Snell and Maehler (1970), slightly adapted; papyrological underdots have been omitted. See also Maehler (2003).

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Nagy has argued that the 'selective marking of accents' (Nagy (2000) 14) in papyri has the function to guide readers in reading aloud the text and 'reflect the traditional patterns of melodic contouring' (Nagy (2000) 21). The 'traditional pattern' cannot be the 'original melody' composed by Bacchylides. Several cola do not have any accent. In Bacchylides 5 we have 140 accents for 200 cola (in the preserved section, we find 620 words that could have received an accent). We find one accent every 4.25 words (or every 1.35 lines). Moreover, it is clear that accents often signal difficult combinations (B. 5.165 ἥρᾳ). However, Nagy is completely convincing in suggesting that accents and colometry guided the delivery of ancient readers in Hellenistic and imperial times.

Dionysius of Halicarnassus tells us that linguistic and metrical cola differed.[40] The rhetorical 'divisions' (*diastolai*) he introduced into his example (Simon. 543 *PMG*) are not clear, and we are uncertain about its metrical analysis. This example cannot be profitably discussed, but it is worth checking whether we do find some traces of an influence of syntax on the division into cola favoured by ancient scholars.

It has been noted that ancient colometries often divide at word end, even when this is not the best possible metrical interpretation.[41] This impression can be substantiated by the analysis of the Bacchylides papyrus. If we analyse the first strophe and antistrophe in 12 sufficiently well-preserved poems by Bacchylides, we find 138 cola.[42] In the first strophes we have 13 instances of word division between two cola (9.5 %); in the first antistrophes we find 20 such cases (14.5 %). The difference is statistically significant, and, in some cases, very striking. In Bacchylides 5, we find only one word division in the first strophe, against 5 in the first antistrophe; in Bacchylides 17, the numbers are 1 against 6.[43]

If we look at syntactic structures, Pindar's famous fragment 169a, νόμος ὁ πάντων βασιλεύς, is a good example: in the first strophe we have coincidence of linguistic and metrical cola (if we accept Snell's supplements in lines 9–13). The only clash is at line 4, where a metrical boundary separates the verb from the instrumental phrase.

Ancient Greek scholars divided lyric texts into cola on the basis of their interpretation of metre. However, colometry has other effects as well. In several cases,

[40] D. H. *Comp.* 140.18–141. 5 ed. Usener and Radermacher (1899).

[41] 'The impression is of a rather slapdash procedure: division follows word-end in the first stanza and the rest of the poem is made to fit' (Parker (2001) 43).

[42] I have analysed 2, 3, 4, 5, 6, 9, 11, 14, 17, 18, 19, 20B, 20C in Snell and Maehler (1970).

[43] We can also point out that, in Bacchylides 5, the metrical interpretation of the papyrus requires word division between cola in 3 cases only in strophes, but in 11 cases in antistrophes (we also have 3 cases for the epodes). The manuscript wrongly avoided splitting a word once in the first strophe and twice in the epodes 4 and 5.

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it does to Pindar and Bacchylides what some modern analyses do to Homeric texts:[44] it highlights the syntactic structures of the first strophe, or helps reconstructing it, helping readers who approach the text. This is a service done to readers, and to their cognitive skills. Colometry gives us the performance style of Roman-time readers, not that of archaic poets.[45]

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[44] Bakker (1997).

[44] This paper was presented at the 'Cognitive Classics' conference, organised by F. Budelmann and N. Lowe on July 4–5, 2008 in London (the Open University, Royal Holloway, University of London, and the Institute of Classical Studies) and at the University of California, Davis, on April 27, 2009, thanks to the invitation of Seth Schein. I thank the organisers and participants for their comments. My department (progetto di internazionalizzazione, 2008) and the Fondazione Cassa Risparmio di Torino (progetto 'teatro classico' 2008) helped with research funds, as well as the institutions listed above.

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BIBLIOGRAPHY

Adorno, F. *et al.* [Adorno, F., Carlini, A., Decleva Caizzi, F., Funghi, M. S., Manetti, D., Manfredi, M., and Montanari, F.] (general eds.) (1995) *Corpus dei papiri filosofici greci e latini. Parte III: Commentari*, Florence.

Adorno, F. *et al.* [Adorno, F., Bastianini, G., Carlini, A., Decleva Caizzi, F., Funghi, M. S., Manetti, D., Manfredi, M., Montanari, F., and Sedley, D.] (general eds.) (2008) *Corpus dei papiri filosofici greci e latini. Parte I.2: Cultura e filosofia (Galenus–Isocrates)*, Florence.

Anderson, R. D., Parsons, P. J., and Nisbet, R. G. M. (1979) 'Elegiacs by Gallus from Qasr Ibrim', *JRS* 69, 125–55.

Aujac, G. and Lebel, M. (eds.) (1981) *Denys d'Halicarnasse. La composition stylistique*, Paris.

Bakker, E. J. (1997) *Poetry in speech: orality and Homeric discourse*, Ithaca–London.

Balogh, J. (1927) '*Voces Paginarum*: Beiträge zur Geschichte des lauten Lesens und Schreibens', *Philologus* 82, 84–109 and 202–40.

Bastianini, G. and Sedley, D.N. (1995) '9. Commentarium in Platonis «Theaetetum». PBerol inv. 9782', in Adorno *et al.* (1995) 227–562.

Bélis, A. (2004) 'Un papyrus musical inédit au Louvre', *CRAI* fasc. 3, 1305–29.

Birt, T. (1882) *Das antike Buchwesen*, Berlin.

Brinkmann, A. (1912) '*Scriptio continua* und anderes', *RhM* 67, 609–30.

Brunschwig, J. and Lloyd, G. E. R. (eds.) (2005) *Il sapere greco. Dizionario critico* (Italian translation of *Le savoir grec*, Paris (1996), with bibliographical addenda).

Burnyeat, M. F. (1997) 'Postscript on silent reading', *CQ* 47, 74–6.

Busch, S. (2002) 'Lautes und leises Lesen in der Antike', *RhM* 145, 1–45.

Butterworth, B. and Yin, W. (1991) 'The universality of two routines for reading: evidence from Chinese dyslexia', *Proceedings of the Royal Society of London, Biological Sciences*, volume 246, number 1315, 91–4.

Calabi Limentani, I. (1991) *Epigrafia latina* (4th edn.), Bologna.

Cavallo, G. (1983) *Libri scritture e scribi a Ercolano*, Primo supplemento a Cronache Ercolanesi 13/1983, Naples.

—— (2008) *La scrittura greca e latina dei papiri. Una introduzione*, Pisa–Rome.

Clark, W. P. (1931) 'Ancient reading', *CJ* 26, 698–700.

Clarysse, W. and Tait, W. J. (1980) 'n. 38', in P. Westman (ed.) *Greek and demotic texts from the Zenon archive*: P. L. Bat. 20, Leiden, 157–64.

Coulmas, F. (2003) *Writing systems: an introduction to their linguistic analysis*, Cambridge.

Del Corso, L. (2005) *La lettura nel mondo ellenistico*, Rome–Bari.

Dickey, E. (2007) *Ancient Greek scholarship*, Oxford.

Diels, H. (1882) 'Stichometrisches', *Hermes* 17, 377–84.

https://doi.org/10.1017/S1750270500000166 Published online by Cambridge University Press

Epelboim, J., Booth, J. R., and Steinman, R. M. (1994). 'Reading unspaced text: implications for theories of eye movements', *Vision Research* 34, 1735–66.

—— (1996) 'Much ado about nothing: the place of space in text', *Vision Research* 36, 465–70.

Frost, R. (2005) 'Orthographic systems and skilled word recognition processes in reading', in Snowling and Hulme (2005) 272–95.

Gavrilov, A. K. (1997) 'Techniques of reading in classical antiquity', *CQ* 47, 56–73.

Gentili, B. (2002) '*Addendum*. La memoria operativa e la colometria del testo poetico', *QUCC* n.s. 71, n. 2, 21–3.

Gentili, B. and Lomiento, L. (2001) 'Colometria antica e filologia moderna', *QUCC* n. s. 69, n. 3, 7–22.

—— (2003) *Metrica e ritmica. Storia delle forme poetiche nella Grecia arcaica*, Milan.

Graux, C. (1878) 'Nouvelles recherches sur la stichometrie', *Revue de philologie*, n.s. 2, 97–143.

Harding, Ph. (2006) *Didymos on Demosthenes*, Oxford.

Harris, J. R. (1883) 'Stichometry', *AJPh* 4, 133–57 and 309–31.

Harris, W. V. (1989) *Ancient literacy*, Cambridge Mass. –London.

Haslam, M. W. (1980) '3329 *Lexicon* (Diogenianus?)' in R. A. Coles, M. W. Haslam (eds.) *The Oxyrhynchus papyri*, Volume XLVII, London, 44–8.

Huby, P. and Neal, G. (eds.) (1989) *The criterion of truth: essays written in honour of George Kerferd together with a text and translation (with annotations) of Ptolemy's* On the kriterion and hegemonikon, Liverpool.

Inhoff, A. W., Radach, R., and Heller, D. (2000) 'Complex compounds in German: interword spaces facilitate segmentation but hinder assignment of meaning', *Journal of Memory and Language* 42 (2000) 23–50.

Janko, R. (ed.) (2000) *Philodemus: on poems, book one*, Oxford.

Jeffery, L. H. (1990) *The local scripts of archaic Greece*, revised edition with a revised supplement by A. W. Johnston, Oxford.

Johnson, W. A. (2000a) 'Toward a sociology of reading in classical antiquity', *AJPh* 121, 593–627.

—— (2000b) 'Musical evenings in the early empire: new evidence from a Greek papyrus with musical notation', *JHS* 120, 57–85.

—— (2004) *Bookrolls and scribes in Oxyrhynchus*, Toronto.

Kajii, N., Nazir, T. A., and Osaka, N. (2001) 'Eye movement control in reading unspaced text: the case of the Japanese script', *Vision Research* 41, 2503–10.

Kenyon, F. G. (1897) *The poems of Bacchylides*, London.

Kenyon, F. G. (1951) *Books and readers in ancient Greece and Rome* (2nd edn.), Oxford.

https://doi.org/10.1017/S1750270500000166 Published online by Cambridge University Press

Kinsler, V. and Carpenter, R. H. S. (1995) 'Saccadic eye movements while reading music', *Vision Research* 35, 1447–58.

Knox, B. M. W. (1968) 'Silent reading in antiquity', *GRBS* 9, 421–35.

Kohsom, C. and Gobet, F. (1997) 'Adding spaces to Thai and English: effects on reading', in M. G. Shafto and P. Langley (eds.) *Proceedings of the 19th Annual Meeting of the Cognitive Science Society (Stanford University, August 7–10, 1997)*, Mahwah, NJ, 388–93.

Kouremenos, T., Parássoglou, G. M., and Tsantsanoglou, K. (eds.) (2006) *The Derveni Papyrus*, Florence.

Kroll, W. (ed.) (1913) *M. Tullii Ciceronis* Orator, erklärt von W. K., Berlin.

Lammert, F. (ed.) (1961) 'De judicandi facultate et animi principatu', in F. Lammert and Ae. Boer (eds.) *Claudii Ptolemaei opera quae extant omnia, vol. III* 2 (editio altera correctior), Leipzig, iii–xvi and 3–36.

Lang, F. G. (1999) 'Schreiben nach Mass. Zur Stichometrie in der antiken Literatur', *Novum Testamentum* 41, 40–57.

Larson, K. (2004) 'The science of word recognition or how I learned to stop worrying and love the bouma' (http://www.microsoft.com/typography/ctfonts/wordrecognition.aspx).

Lomiento, L. (2007) Review of Prauscello (2006), BMCR 2007.04.57 (http://bmcr.brynmawr.edu/2007/2007-04-57.html)

Long, A. (1989) 'Ptolemy on the criterion: an epistemology for the practising scientist' in Huby and Neal (1989) 151–78.

Long, A. *et al.* [Long, A., Kerferd, G., Blumenthal, H., Fox, N., Huby, P., Robinson, H., Lloyd, A. C., Neal, G., and Nagase, M.] '*On the kriterion and hegemonikon. Claudius Ptolemaeus*' in Huby and Neal (1989) 179–230.

Lyman, R. S., Kwan, S. T., and Chao, W. H. (1938) 'Left occipito-parietal tumor with observations on alexia and agraphia in Chinese and in English', *Chinese Medical Journal* 54, 491–515 [*non vidi*].

Maehler, H. (ed.) (2003) *Bacchylides: carmina cum fragmentis* (11th edn.), Stuttgart and Leipzig.

Manuli, P. (1981) 'Claudio Tolomeo: il criterio e il principio', *Rivista critica di storia della filosofia* 36: 64–88.

Nagy, G. (2000) 'Reading Greek poetry aloud: evidence from the Bacchylides papyri', *QUCC* n.s. 64, n. 1, 7–38.

Obbink, D. (ed.) (1996) *Philodemus: on piety, part* I, Oxford.

Ohly, K. (1928) *Stichometrische Untersuchungen*, Leipzig.

Pace, G. (2002) 'Il termine περίοδος nella dottrina metrica e ritmica antica', *QUCC* n.s. 71, n. 2, 25–46.

https://doi.org/10.1017/S1750270500000166 Published online by Cambridge University Press

Parker, L. P. E. (2001) 'Consilium et ratio? Papyrus A of Bacchylides and Alexandrian metrical scholarship', *CQ* 51, 23–52.
Parsons, P. (2003) 'Stichometry' in S. Hornblower and A. Spawforth (eds.) *The Oxford Classical Dictionary* (3rd edn. revised), Oxford, 1443.
Pestman, P. W. (1981) *A guide to the Zenon archive*, P. L. Bat. 21, Leiden.
Pernigotti, C. (ed.) (2008) *Menandri Sententiae*, Florence.
Pöhlmann, E. and West, M. L. (eds.) (2001) *Documents of ancient Greek music*, Oxford.
Prauscello, L. (2006) *Singing Alexandria: music between practice and textual transmission*. Leiden–Boston.
Rayner, K., Fischer, M. H., and Pollatsek, A. (1998) 'Unspaced text interferes with both word identification and eye movement control', *Vision Research* 38, 1129–44.
Rayner, K., Juhasz, B. J., and Pollatsek, A. (2005) 'Eye movements during reading' in Snowling and Hulme (2005) 79–97.
Rayner, K. and Pollatsek, A. (1996) 'Reading unspaced text is not easy: comments on the implications of Epelboim *et al.*'s study (1994) for models of eye movement control in reading', *Vision Research* 36, 461–5.
Richardson, N. J. (1975) 'Homeric professors in the age of the sophists', *PCPhS* 21.65–81 (reprinted in A. Laird (ed.) (2005) *Oxford readings in ancient literary criticism*, Oxford, 62–86.
Rogers, H. (2005) *Writing systems: a linguistic approach*, Oxford.
Saenger, P. (1997) *Space between words: the origins of silent reading*, Stanford.
Sainio, M. *et al.* [Sainio, M., Hyönä, J., Bingushi, K., and Bertram, R.] (2007) 'The role of interword spacing in reading Japanese: an eye movement study', *Vision Research* 47, 2575–84.
Santini, C., Mastrorosa, I., and Zumbo, A. (eds.) (2002) *Letteratura scientifica e tecnica di Grecia e Roma*, Rome.
Slusser, M. (1992) 'Reading silently in antiquity', *Journal of Biblical literature* 111, 499.
Snell, B. and Maehler, H. (eds.) (1970) *Bacchylides* (10th edn.), Leipzig.
Snowling, M. J. and Hulme, C. (2005) *The Science of reading: a handbook*, Oxford.
Usener, H. and Radermacher, L. (eds.) (1899) *Dionysius Halicarnaseus: quae extant. Vol. VI. Opuscula II*, Leipzig.
Usher, S. (ed.) (1985) *Dionysius of Halicarnassus: the critical essays, II*, Cambridge, Mass. –London.
Valeri, V. (2001) *La scrittura*, Rome.
Wang, J., Inhoff, A. W., and Chen, H.-C. (1999) *Reading Chinese script: a cognitive analysis*, Mahwah, New Jersey–London.
West, M. L. (2007) 'A new musical papyrus: Carcinus, *Medea*', *ZPE* 161, 1–10.

https://doi.org/10.1017/S1750270500000166 Published online by Cambridge University Press

Willett, S. (2002) 'Working memory and its constraints on colometry', *QUCC* n.s. 71, n. 2, 7–19.

Wolf, M. (2008) *Proust and the squid: the story and science of the reading brain*, London 2008 [original edn. New York 2007].

https://doi.org/10.1017/S1750270500000166 Published online by Cambridge University Press