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Manuscripts as Evidence for the use of Classics in Education, *c.* 800–1200

Estimating the Randomness of Survival

Abstract

Are the surviving copies of schooltexts representative of what was popularly used in schools in the medieval period? In other words, was the survival of these manuscripts a random or selective process? To approach this question, this article presents a series of comparisons between the numbers of manuscripts of different schooltexts. It demonstrates that the most popular schooltexts all survive in very similar numbers from each century, and that the typical number of copies varies from one century to another. The easiest explanation for such a survival pattern is to assume that the texts were produced in equal numbers and passed through a relatively random filter of losses. The article seeks to test this intuitive explanation by using a simple probability mathematical experiment. In addition, the article analyses how the numbers of surviving manuscripts relate to entries in medieval book lists and medieval library catalogues. This examination supports the interpretation that the survival of schooltexts was a relatively random process. In addition, comparison between medieval book lists and extant manuscripts advocates caution in using the book lists as evidence for the popularity of texts in the medieval centuries. Even though the catalogues provide snapshots of specific historical situations, this paper concludes that the mass of extant books is more likely to give us a realistic picture of the contemporary popularity of texts.

Although not so for everyone, going to school to learn Latin was an everyday phenomenon in medieval Europe and like many everyday phenomena it has left relatively few traces in narrative and documentary sources. In social and economic history, archeological data – its accumulation and increased use by historians – has revolutionised

our understanding of early-medieval societies (*e.g.* McCormick, Wickham, Fleming, and Loveluck). For the schools, the equivalent of archeological evidence comes in the form of schoolbooks. But like all material evidence, this is not straightforward to interpret. The fact that the manuscripts do not survive under the ground but in libraries hardly makes things less complicated.

The main question that underlies the following enquiry is whether we can assume that the surviving copies of Latin school texts are representative of what once existed. It is clear that books from different contexts survive differently. For instance, the poor survival of liturgical books is well attested.[1] But can we assume that the chances of survival for different kinds of texts used in school context were similar, and similarly random? To approach this question, I will first present a series of comparisons between the numbers of copies of different kinds of popular school texts over time. Secondly, I will examine how the numbers of the surviving manuscripts relate to mentions in medieval book lists and library catalogues, using a simple experimental heuristic. I do not claim that I am doing anything revolutionary. Indeed, the following observations are best seen as marginalia on the decades of work undertaken by Birger Munk Olsen. Much of the data I will be examining comes directly from his catalogue, and many of the observations have been prefigured in his work.[2]

However, the comparisons are novel and they bring out patterns that no one has, to my knowledge, pointed out before. In my view, the hypothesis that best explains the observed patterns is that books that were used in the study of Latin did in fact have roughly similar destinies over the centuries, regardless of whether they were works of pagan or Christian authors, or poetry or prose. In other words, we can trace the development of the content of the curriculum by comparing the numbers of surviving manuscripts across centuries.[3] Furthermore, the comparison with medieval book lists advocates caution in using the lists as historical evidence. Even though the catalogues provide snapshots of specific contemporary situations, this study suggests that what they list cannot be taken as representative of the mass of books that once existed. In particular, the catalogues may overrepresent obsolete works piling up in library collections. The surviving manuscripts have been subjected to centuries of destruction, but it appears that they nevertheless provide a better idea about what kinds of books were used and produced at a specific time than the book lists, at least in the case of Latin schooltexts.

1. For instance in England, only *c.* 90 from the estimated 40 000 Missals existing at *c.* 1400 survive. See Morgan 291.

2. Munk Olsen, *L'étude des auteurs classiques I–IV.* See in particular vol. IV.2 (*La réception de la littérature classique*). Other important contributions have been collected in Munk Olsen, *La réception de la littérature classique.*

3. For such an attempt, see Tahkokallio.

Before entering the actual discussion, I should clarify that throughout this paper I am principally discussing what may be termed secondary Latin education. It is thought that boys would have learned to read with the Psalter and some simple texts, such as *Disticha Catonis*.[4] After this initial stage, those with higher scholarly or professional aspirations (and financial means) would have continued on a sort of advanced Latin course, engaging with stylistically exemplary authors. This kind of study, typically taking place at a cathedral school, was essential for developing the Latin competence needed for a career in ecclesiastical or lay administration or in pursuing the higher reaches of learning. It is the textual basis of this education that this article concentrates on.

Numbers of surviving manuscripts of the Latin curriculum core texts

In the pre-Carolingian period, advanced Latin was apparently studied mainly through the late antique Christian poets and Virgil, the only classical author in the curriculum (Riché 121–39; Green 351–72). This idea is based primarily on narrative sources, such as autobiographical poems about one's education.[5] The relevant evidence has been surveyed comprehensively by Günter Glauche in his *Schullektüre im Mittelalter* (5–16).[6] In the six pre-Carolingian and early Carolingian sources cited, the following authors crop up with the greatest frequency:

Prudentius – six appearances
Arator, Sedulius, Iuvencus – five appearances
Avitus of Vienne, Virgil – four appearances

Let us compare how these authors appear in narrative sources with how many copies of their manuscripts from before 800 survive today.[7]

4. See for example Gwara 512–16 and 518–21, Contreni 116–21, and Reynolds 7–16.

5. Reference by early medieval authors to the exemplarity of such writers, and allusions to them, are the other main evidence for this. For instance, for Bede's relationship to Sedulius, see Heikkinen 9–11.

6. Glauche's souces are Venantius Fortunatus (*c.* 540–*c.* 600), *Vita Sancti Martini*; *Versus Isidori* (early seventh century); Alcuin (*c.* 735–804), *Versus de patribus regibus et sanctis Euboricensis ecclesie*; Theodulf (*c.* 760–821), *De libris quos legere solebam*; *Versus Walahfridi* (dating unclear, but probably early ninth century; see Glauche 13); Hrabanus Maurus (780–856), *Versus ad amicum, De institutione clericorum*.

7. The studies and catalogues from which the numbers of manuscripts throughout this article derive have been listed in an appendix.

Table 1.
Main authors of the pre-Carolingian Latin curriculum.

Author	Mentions in narratives	Surviving	manuscripts		
		pre 600	7th c.	8th c.	All
Prudentius	6	1	1	2	4
Arator	5	0	0	0	0
Sedulius	5	1	1	7	9
Juvencus	5	0	0	4	4
Virgil	4	6	0	3	9
Avitus	4	0	0	0	0

As we can see, before ca. 800 there is no real correlation between the position in the list of narrative sources and the numbers of surviving copies. No copies survive of the works of Arator and Avitus that nevertheless should have been very popular. In fact, very few copies of any texts are extant from before 700 – with the exception of Virgil.

This data is in line with the overall picture of the survival of Latin manuscripts from before the Carolingian period. According to Eltjo Buringh's calculations, there survive *c.* 250 Latin manuscripts from the sixth, likewise *c.* 250 from the seventh, and *c.* 1400 from the eighth century (Buringh 261, table 5.5). While it is difficult to know what proportion of contemporary production these manuscripts represent, it is certain that the sixth- and seventh-century ones in particular cannot be but tiny fractions of what once existed. In other words, the destruction of material from this early period has been near complete and the odds of survival for each pre-ninth-century book are very low, probably less (and possibly much less) than 1%, at least before AD 700.

This has implications for how the extant manuscripts can be used as evidence for contemporary book production. For the sake of exemplifying this, let us make the entirely arbitrary assumption that there would have existed one hundred seventh-century copies of Arator, and each would have had a 0.5% chance of surviving to the present. We can estimate how many would typically survive by a calculation of the binomial distribution, a common probability mathematics operation.[8] An examination of the binomial distribution is used to answer questions of the following type: if we toss a coin ten times, what are the odds of having 0 tails, 1 tail, 2 tails, 3 tails etc.? With these assumed figures – manuscript population of 100 copies, 0.5% probability of survival – there is a 60.6% chance none survives, 30% chance that one survives, 7.6% chance that two survive and 1% chance that three survive. Thus, it would be perfectly possible that no seventh-century copies of a popular text survive, and it would likewise be perfectly possible that two or even three survive. The differences between possible results are huge in relative terms. One is infinitely more than zero, and three is 300% of one. In this case, it is difficult on purely mathematical grounds to draw any conclusions concerning the number of manuscripts produced from the number of surviving ones. The enormity of the losses and the randomness of survival blocks the seventh-century reality from our view. Furthermore, the empirical evidence suggests that the level of interest of later periods and the quality of the books themselves have played an

8. The binomial distribution equation for calculating the probability of survival for a certain number of manuscripts (n) is $P=N!/(n!(N-n)!)*p(N-n)*(1-p)n$. N=original number of mss, p=probability of destruction. There are various tools and programmes for calculating binomial distributions. I have used the freely available calculator.

important role in determining what survives. Obviously *Vergilius Vaticanus* (fourth century), *Vergilius Mediceus* (second half of the fourth century) and *Vergilius Romanus* (second half of the fifth century) are still with us because they have been treasured by generations of readers, both because the author has been relevant ever since and because of the exceptionally high quality of the books.[9]

However, in the ninth century the patterns of manuscript survival change dramatically. Let us look at the numbers of copies of the texts that formed the core of the Latin curriculum in *c.* 800. Of these, I have been able to collect reliable data for Prudentius, Arator, Sedulius, and Virgil for the whole period under examination (800–1200), and I also include Juvencus for the ninth century, even though his figures are not reliable afterwards. Good-quality data is also easily available for two other schooltexts – Boethius' *De consolatione Philosophiae* and Martianus Capella's *De nuptis Philologiae et Mercurii*.[10] Even though they were not primarily used for the study of the Latin language, I introduce these texts to the comparison because of the prima facie likelihood that they had a similarly central position in the curriculum and are therefore likely to have been produced in similar numbers.

9. Città del Vaticano, Biblioteca Apostolica Vaticana (BAV), Vat. lat. 3225 (*Vergilius Vaticanus*), Firenze, Biblioteca Medicea Laurenziana, xxxix.1, BAV, Vat. lat. 3225 (*Vergilius Mediceus*), and BAV, Vat. lat. 3867 (*Vergilius Romanus*).

10. The sources of the data have been laid out in the appendix.

Table 2. Numbers of surviving manuscripts for the most popular schooltexts, 9th century

Century	Arator	Juvencus	Sedulius	Prud. *Psych.*	Virgil *Aeneid*	Boethius *De cons.*	Martianus Capella
9th	11	17	27	29	37	21	28

As we can see, all these curriculum texts exist in substantial numbers of ninth-century copies and the only author who does not appear to be as popular as is indicated by the narrative sources (admittedly from a slightly earlier period) is Arator. Virgil is alone at the top, but two things should be noted about this. Firstly, ninth-century copies of his works are of larger size than those of other texts, which may indicate that they were also used outside the school context.[11] Secondly, the early-Christian authors may not be quite as thoroughly studied and catalogued as the classical ones. For instance, in 1984 Munk Olsen had counted 29 ninth-century copies of the *Aeneid*, but his most recent list runs to 37, which well demonstrates the effect of decades of concentrated work.

These minor differences apart, the important thing to note is the relatively narrow range within which the numbers of surviving copies fall for most texts. Five of the authors survive in between 21–29

11. The average size of the page is 708 cm² for Virgil, while it is 491cm² for Arator, 478cm² for Sedulius, and 460 cm² for Boethius. See Tahkokallio 136–37, tables 4 and 5. Large size is usually associated with 'library books,' small size with 'school books.' This logic is not without problems when assessing the intended use of an individual book, but in large populations of manuscripts the size should function as an indicator of the book's original function. For different kinds of books and their typical sizes, see Gameson 22–34.

copies (the average of all being 24). Intuitively, the most plausible explanation for the narrow range appears to be that these texts were originally produced in similar numbers and have then passed through a similar filter of losses over the centuries.

We can conduct a mathematical experiment to test this assumption, using again the binomial distribution. If these texts had once existed in equal numbers and would have passed through a similar filter, what kind of a spectrum of surviving copies would we be likely to see? To conduct an experiment of this kind with the manuscripts, we need to come up with an imagined population of books and an assumed surviving probability. To obtain these figures, I use the most recent mathematical estimates presented by Eltjo Buringh in his important if somewhat controversial work.[12] I would like to emphasise that I am not assuming that his figures are necessarily correct ones, and that to make the experiment work they do not need to be so. In fact, an examination of the binomial distribution of any fairly large population (say, more than 200) with a relatively low probability of survival (say, between 1–10%) would yield results showing us roughly what kind of a range to expect and providing a check on our intuition. Nevertheless, I consider Buringh's figures to be better than imagined ones, and they provide added value to this experiment.

Buringh puts the survival rate of ninth-century manuscripts at ca. 4.2%. In other words, we would need to multiply the figures of surviving manuscripts by 24 to arrive at the numbers that once existed. Let us for the sake of an experiment count back with this multiplier. Multiplying the average number of popular school texts (24) by 24 gives us 576. If each copy had a 4.2% chance of surviving to the present, there would be a 98% probability that the numbers observed for each text would now be between 14 and 36, and an 80% probability they would be between 18–30. As it is, the surviving numbers of these ninth-century manuscripts fall within a very similar range, with the low exception of Arator and high exception of Virgil just outside of it.

Let us move on to examine how these figures work out for the next centuries. The following table shows the tenth-century situation and it brings in four authors that now survive in similar numbers as the established texts of the pre-Carolingian era: Horace (*Satires*), Lucan, Juvenal and Terence. It furthermore excludes Iuvencus, for whom the data is not solid enough after the ninth century.

12. Buringh is severely criticised by Maniaci. For a positive review, see Epstein.

Table 3.

Numbers of surviving manuscripts for the most popular schooltexts, 10th century

Century	Arator	Sedulius	Prud. *Psych.*	Virgil *Aeneid*	Horace *Satires*	Lucan	Juvenal	Teren.	Boethius *De cons.*	Mart. Cap.
10th	15	18	18	25	15	14	23	18	21	18

Overall, we see a clear and well-known drop in the number of surviving copies. No doubt this reflects diminishing production, even more so because the ninth-century manuscripts have been exposed to more losses than the tenth-century ones. But again all these texts survive in numbers falling within a very narrow range, indeed even more so than in the ninth century. The quantities of copies vary between 14 and 25, with an average of 18.5. Let us construct a hypothetical binomial distribution for the survival odds of the tenth-century manuscripts as well. Buringh's survival rate for the century is *c.* 5.6 %, which means we should multiply by *c.* 18 to arrive at production figures. Using the hypothetical manuscript population size resulting from the multiplication (18 x 18.5 = 333) and Buringh's survival rate, there is a 98% probability that the number of surviving copies would be between 10 and 29 and an 80% probability that it would fall between 14 and 25, which is precisely the range seen in the dataset.

The next table shows the manuscript count for the most popular schooltexts in the eleventh century. We see an increasing quantity of classical texts surviving in similarly high figures and seven of them are now more numerous than the most popular early Christian authors.

Table 4.

Numbers of surviving manuscripts for the most popular schooltexts, 11th century

Cent.	Arat.	Sedul.	Prud. *Psych.*	Virgil *Aeneid*	Hor. *Satires*	Lucan	Cicero *De inv.*	Sallust *Jug.*	Juv.	Teren.	Boeth. *De cons.*	Mart. Cap.
11th	30	24	30	47	44	32	33	37	36	34	43	17

The range within which the numbers fall into remains restricted. The average number for the twelve texts included is 34, with the lowest number being 17 and the highest 44. However, the texts with the smallest numbers may well be ones that were losing their position, since so many works survive in 30+ copies. Buringh estimates a *c.* 7.5% survival rate for eleventh-century manuscripts, which means multiplying by 13.25 to arrive at the production figures. Counting with the average number of 34, this means a hypothetical population

of 451. The by-now familiar experiment with the binomial distribution shows that a text produced in this number of copies in the eleventh century (with a 7.5% survival rate) would with 98% probability now exist in 21–47 with 80% probability in 27–41 copies.

The twelfth century presents a real explosion, partly but not primarily explained by the better survival chances of these more recent copies. Now we see more variation in the numbers, but it is obvious that this reflects changes in the curriculum. In fact, while the tenth and eleventh centuries show the diversity of texts increasing – experimenting with new texts – the twelfth suggests a diminishing range of core texts and the consolidation of a more widely shared common curriculum.

Table 5.
Numbers of surviving manuscripts for the most popular schooltexts, 12th century

Cent.	Arat.	Sedul.	Prud. *Psych.*	Virgil *Aeneid*	Hor. *Satires*	Lucan	Cicero *De inv.*	Sallust *Jug.*	Juv.	Teren.	Boeth. *De cons.*	Mart. Cap.
12th	22	24	25	85	84	118	128	94	52	50	39	35

The differences between the low and high numbers are now such that they must reflect very different production figures. The Christian poets have obviously lost their former importance, and Boethius and Martianus Capella also seem to be going out of fashion. What stand out are the five most popular classical authors: Virgil, Horace, Lucan, Cicero and Sallust, all within the range of 85–128 surviving copies. Their average is a whopping 112. In Buringh's estimate, 10% of the production would survive for the twelfth century. If we assume that the production figures for the most popular texts would have been ca. 1120 (with survival rate of 10%) the binomial distribution experiment shows us that the there would be 98% probability for the numbers of surviving copies falling within 88–135 and an 80% probability for the range being 99–125.

Finally, the following table summarises the development over the centuries. The authors that appear to represent the most important curriculum texts, based on the number of surviving manuscripts, are highlighted.

Table 6.
The numbers of surviving manuscripts for the most popular schooltexts, 9th–12th centuries

Cent.	Arat.	Sedul.	Prud. *Psych.*	Virgil *Aeneid*	Hor. *Satires*	Lucan	Cicero *De inv.*	Sallust *Jug.*	Juv.	Teren.	Boeth. *De cons.*	Mart. Cap.
9th	11	27	29	37	4	10	5	2	7	6	21	28
10th	15	18	18	25	15	14	9	7	23	18	21	18
11th	30	24	30	47	44	32	33	37	36	34	43	17
12th	22	24	25	85	84	118	128	94	52	50	39	35

The table shows us the narrow range within which the numbers of copies of the most popular schooltexts fall during each century. As I have sought to argue, the easiest explantion for the similar numbers is that these texts were produced in comparable quantities and went through a relatively random filter of survival. The experiments with the binomial distribution demonstrate that the figures are compatible with this intuitive assumption.

Comparison with grammar books

Hitherto we have been comparing the numbers of copies of works that probably had a similar position in the curriculum. Let us see next how the average figures of the most popular *auctores* tally with Priscian's grammar. Provided that the assumption about similar odds of survival for different kinds of books used at schools is correct, the numbers of surviving manuscripts should follow similar trends as those of the authors examined above. In the following comparison, I have omitted extracts of less than ten folios, but included fragments which probably represent once-complete copies.

Table 7. Numbers of copies of Priscian's grammar

9th century	60
10th century	39
11th century	74
12th century	243

The numbers are higher than those of the typical Latin school texts. This seems logical, considering that a grammatical text would probably have been used earlier in the course of studies, and thus with more numerous students. Likewise, while every scholarly context did not need precisely the same set of *auctores*, all would have needed a grammar. The trend of survival appears very similar to the Latin texts. The following table, showing the ratio of the surviving Priscian manuscripts to the average number of the popular school texts (see above), confirms this observation.

Table 8. Ratios of the surviving copies of Priscian to the average number of surviving manuscripts of the most popular Latin authors

9th century	2,50
10th century	2,11
11th century	2,18
12th century	2,17

As we can see, grammars were slightly more than twice as common as the most popular school texts throughout this period. The relative constancy of the ratio of grammars to texts supports the idea that the numbers of surviving manuscripts reflect the relative popularity of these texts in the centuries when the copies were produced, and that the process of survival was random. It also adds to the impression that the early-Christian poets lost their importance over the eleventh and twelfth centuries, since their numbers decline not only in relation to the pagan classics but also to Priscian.

Library catalogues and book lists

Another way to try to check the randomness of manuscript survival is by consulting medieval book lists. As snapshots of the medieval reality, their picture is not similarly distorted by the processes of survival. Do the numbers of surviving manuscripts correlate with the frequency with which the authors appear in medieval book lists?

Before answering this question, it is necessary to recall several caveats that apply to book lists as evidence. Firstly, most of them were produced in large monastic libraries. Provided that small collections differed in content from large ones, which seems probable, they are thus likely to give us a biased picture of the contemporary populari-

13. I would expect that book lists are likely to make rare texts seem too common and common texts seem too rare. Large collections probably had many more texts of marginal importance than small ones.

14. Munk Olsen, *L'étude* 4.2 calculates the ratios but only for authors with just one work, since in these cases there is no uncertainty about what a book list refers to. Harald Anderson has conducted a similar experiment with Statius; see Anderson 1.iv (fig. 2).

ty of texts.[13] Secondly, there are geographical biases. France and Germany dominate the picture because many more early book lists survive from there than, for example, from Italy. Furthermore, even France and Germany are not equally represented across the centuries. In the ninth century, *c.* 80% of the entries derive from German catalogues, whereas in the twelfth century twice as many come from French lists as from German ones. As a consequence, the picture that the book lists provide cannot be representative if collections varied from one geographical region to another, which they may have done to some extent. Thirdly, book lists cannot be trusted to include everything that an institution possessed – indeed, it seems probable that every one of them misses a number of books that were in one way or another present at the institution. Fourthly, the survival of book lists was as well a random process, and since their overall numbers are relatively low if compared, for instance, with all surviving copies of schooltexts, they are less reliably representative of what once existed. Fifthly, book lists often indicate only the author, not the text, and they do not necessarily mention every text that a codex contained. Sixthly, it is difficult to decide what century of manuscripts to compare with what century of book lists. Should tenth-century production be compared to tenth-century book lists, even though it is likely that a large share of the works the lists show were in fact copied in the ninth century or even earlier?

Some of the problems are unsolvable, but I have used two experimental heuristics to mitigate the last two. Firstly, if only the author is mentioned, I have simply counted this as an instance of the author's best-known work. Thus, 'Prudentius' has been counted as an instance of *Psychomachia* and 'Virgil' as that of the *Aeneid*, unless the list specifically mentions another work.[14]

Secondly, when calculating the ratios of surviving manuscripts to entries in book lists I have compared the number of book list entries from one century to the numbers of manuscripts from that century and the previous one combined. That is, the appearances of Virgil in twelfth-century lists have been compared to the sum of eleventh- and twelfth-century manuscripts. All the data used in this exercise comes from Max and Karl Manitius, *Handschriften antiker Autoren in mittelalterlichen Bibliothekskatalogen*, which presents a good coverage of the early centuries.

The first table gives the number of entries of the author's main text in the Manitius' lists. The second one contains the ratios of appearances viz-à-viz surviving manuscripts.

Table 9.

Appearances of authors in the book lists and catalogues edited in Manitius

Author	9th cent.	10th cent.	11th cent.	12th cent.
Arator	9	5	35	54
Sedulius	22	11	53	71
Prudentius	14	12	28	28
Virgil	21	14	24	71
Horace	3	3	19	49
Lucan	3	2	11	46
Cicero	7	1	12	49
Sallust	5	1	12	21
Juvenal	6	7	23	37
Terence	5	5	20	49
Boethius	11	10	30	66
Martianus Cap.	6	7	11	44
Priscian	23	15	65	136

Table 10.

Ratio of book list entries to surviving manuscripts. Entries per century (n) / mss of the century n + mss of the century n-1

Author	9th cent.	10th cent.	11th cent.	12th cent.
Arator	0,82	0,19	0,78	1,06
Sedulius	0,67	0,24	1,26	1,48
Prudentius	0,48	0,26	0,58	0,51
Virgil	0,54	0,23	0,33	0,54
Horace	0,75	0,16	0,32	0,38
Lucan	0,30	0,08	0,24	0,31
Cicero	1,40	0,07	0,29	0,30
Sallust	1,67	0,11	0,29	0,17
Juvenal	0,86	0,23	0,39	0,42
Terence	0,83	0,21	0,38	0,58
Boethius	0,52	0,24	0,47	0,80
Martianus Cap.	0,25	0,15	0,31	0,85
Priscian	0,38	0,16	0,63	0,46

As shown by table 10, there are usually more surviving manuscripts than references to the works in book lists. The biggest differences are between centuries rather than between texts, and much depends on the nature of the evidence. The great variation in the ninth-century figures, for instance, is explained by the small samples of both man-

uscripts and book list entries for some texts (for example Sallust), which means that they are random noise rather than meaningful results.[15] The low figures of the tenth century, on the other hand, reflect the fact that very few lists survive from the period.

As to contrasts between types of authors, the ninth-century data does not allow meaningful comparisons. In the tenth century, the ratios are rather similar across the spectrum. However, in the eleventh century we see an interesting break. The numbers of Sedulius's appearances in book lists go up in comparison to the numbers of manuscripts. This trend continues in the twelfth century for Sedulius, with the ratio rising to 1.48, and becomes clearly visible for Arator as well (ratio 1.06). Likewise in the twelfth century Boethius and Martianus Capella appear, comparatively speaking, more often in book lists than do classical texts (ratios 0.80 and 0.85).

In other words, these Christian writers are found in libraries in large numbers but few new manuscripts are visible to us. Does this suggest that the twelfth-century copies of Arator and Sedulius, and perhaps also of Boethius and Martianus Capella, have been subjected to much more destruction than those of the pagan classics? I do not think this is the case, for there is no similar mechanism in action for the earlier centuries and the decreasing number of manuscripts fits the idea that the pagan classics became more important in education in the high-medieval period. Rather, I suspect that we see old copies of Christian authors starting to gather dust in the bookshelves of institutional collections. The frequent appearances of these works in the book lists may well suggest decreasing, rather than increasing, use of these texts.

There is a steady correlation between the numbers of manuscripts and appearances in the book lists across centuries, as the table below demonstrates. The correlations are stronger for classical texts than early-Christian ones. The probable explanation for the lower correlation for the Christian texts is their declining popularity over the eleventh and twelfth centuries, which makes them overrepresented in library collections. Overall, the fact that the 'snapshots,' wanting as they are, provide such a similar picture to that of the surviving manuscripts offers important independent testimony on behalf of the relative randomness of the processes of manuscript survival.

Table 11.

Correlation between book list entries and the numbers of manuscripts across centuries

Arator	0,90
Sedulius	0,49
Prudentius	0,64
Virgil	0,93
Horace	0,99
Cicero	0,99
Sallust	0,95
Juvenal	0,97
Terence	0,96
Lucan	0,99
Boethius	0,90
Martianus Cap.	0,71
Priscian	0,94

Conclusions

All the evidence examined above suggests that the processes by which early- and high-medieval schoolbooks survived to our day were relatively random. The surviving manuscript populations can thus – in the case of Latin texts used in schools – be taken as representative of what once existed. Indeed, I would suggest that the books are the best evidence we have for studying how the curriculum below university level developed over the Middle Ages, also after the period discussed here. This is a topic that has not attracted enough attention. Our vision of later medieval education is dominated by the universities even though a far greater number of people passed through ordinary cathedral schools, which also provided the basic mental furniture for those who went on to higher education. The reason for this bias is obvious. More copious sources, both documents and narratives, inform us about the universities. Here, the study of the schoolbooks, the material record of education, can provide an important corrective.

Some of the methodological experiments I have attempted might also be beneficially applied to other kinds of manuscript populations, informing other kinds of historical questions. The relatively narrow range within which the numbers of copies of the core schooltexts fall

suggests that such texts were typically produced in similar numbers. That is, their production corresponded to a certain level of demand. It would be interesting to see if we could find similar patterns for books of other sorts. Do different types of liturgical books, for instance, survive in similar numbers from each century? How about patristic texts, presumably found in most large monastic collections? It would also be worth checking whether the numbers of these texts follow the binomial distribution as is the case with the schoolbooks. Finding answers to these and similar questions would, I believe, advance our understanding of the mechanisms of manuscript loss and survival. The more we know about how random these procesess were (or were not), the better we are able to use the manuscripts as evidence in the study of medieval intellectual, cultural and social history.

Appendix – The Sources for the Numbers of Manuscripts

The data on the manuscripts and their datings come from the published studies listed below, to which I add some individual manuscripts, mostly located using *Manuscripta Mediaevalia*. For all the texts, I have included fragments in the figures if it seems that they are remnants of a once complete text. Extracts have not been included.

Classical texts

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