4

The historical evolution of phrasal discourse styles in academic writing

4.1 Grammatical complexity in eighteenth century written texts

In the last chapter, we described the ways in which modern academic writing differs in its grammatical discourse style from most other registers of English, including all spoken registers as well as most other written registers. The findings in Chapter 3 are surprising in two major respects: on the one hand, grammatical features associated with complexity in previous research turn out to be *not* frequent in academic writing, but at the same time, other features that have been overlooked in most previous studies turn out to be especially prevalent in academic writing.

For example, passive voice verbs have been strongly associated with academic writing in past research, often with a negative evaluation. Corpus research findings show that passive voice verbs are indeed more common in academic writing than in most other registers. However, it is not correct that passives are ubiquitous in academic writing. Rather, passives account for only c. 25% of all finite verbs in academic prose (see Biber et al. 1999: 476). They are reserved for specialized functions, often when it would be redundant to mention that the author is the agent of an action (e.g., in methodology sections of research articles). Similarly, although nominalizations are more common in academic prose than in other registers, they are not especially frequent in absolute terms: Figures 3.8 and 3.11 in Chapter 3 show that nominalizations account for only 10%–15% of all nouns in written academic texts. And surprisingly, that proportion is actually lower in specialist science research articles than it is in the social sciences and humanities (see Figure 3.11).

The most surprising pattern documented in the last chapter is the relatively rare use of dependent clauses in written academic registers, contrasted with much more frequent use of finite clausal structures in spoken registers and popular written registers. Thus, finite adverbial clauses and complement clauses are considerably more common in speech than in academic writing. Finite relative clauses are commonly used in

humanities academic writing, but they are not common in science academic writing. Non-finite dependent clauses functioning as noun modifiers or noun complements have a stronger association with academic writing, yet even these structures are not especially frequent in absolute terms (see Figures 3.9 and 3.12).

So what makes academic writing complex, if most of those grammatical structures traditionally associated with complexity are not prevalent? We argued in the last chapter that the most important distinguishing characteristic of academic writing is its extremely dense use of phrasal structures (i.e., structures without verbs), especially phrases functioning as noun modifiers. These structures include attributive adjectives, nouns as nominal premodifiers, prepositional phrases as nominal post-modifiers, and appositive noun phrases. The dense use of these structures results in a discourse style that minimizes the use of verbs and clauses, relying instead on embedded phrases to convey information. These features have been mostly overlooked in previous research on academic writing, despite their quite frequent use in this register.

English academic writing has not always been this way. Thus, consider the following extended text sample taken from a scientific academic paper published in the *Philosophical Transactions of the Royal Society of London* in 1800. We have **underlined all main verbs**, and marked dependent clauses in [ ].

Text Sample 4.1
Eighteenth/nineteenth century academic science writing

It has long **been** my intention [to **lay** before the Royal Society a few observations on the subject of sound]; and I have **endeavoured** [to **collect** as much information], and [to **make** as many experiments, [**connected** with this inquiry], [as circumstances **enabled** me [to **do**]]]; but, the further [I have **proceeded**], [the more widely the prospect of [what **lay** before me] has been **extended**]; and, [as I **find** [that the investigation, in all its magnitude, will **occupy** the leisure hours of some years, or perhaps of a life]], I **am** determined, in the mean time, [lest any unforeseen circumstances should **prevent** [my **continuing** the pursuit]], [to **submit** to the Society some conclusions [which I have already **formed** from the results of various experiments]].

Thomas Young, M. D. January 16, 1800.
'Outlines of Experiments and Inquiries respecting Sound and Light'
F. R. S. In a Letter to Edward Whitaker Gray, M. D. Sec. R. S.

This text is typical of eighteenth and early nineteenth century science writing in its long, complex sentence structures, with multiple levels of clausal embedding. Both finite and non-finite dependent clauses are common in this discourse style, as shown by the bracketed clauses in Text Sample 4.1. Embedded phrases are also relatively common, especially *of*-phrases (e.g., *the*

subject of sound; the prospect of . . .; the leisure hours of some years, or perhaps of a life; the results of various experiments). However, many of the distinctive phrasal characteristics found in modern academic prose are relatively rare in early science texts, including prepositional noun modifiers other than *of*-phrases and nouns as nominal pre-modifiers. We would clearly characterize this style of writing as grammatically 'complex'; but the complexity involves clausal embedding rather than the dense use of phrasal modifiers.

We show in the present chapter that the stereotypes about grammatical complexity in academic writing (with a dense use of dependent clauses) provide an accurate portrayal of science writing as it existed in earlier centuries, suggesting that this might be the source of those characterizations. However, as we have illustrated in detail in Chapter 3, the eighteenth century discourse style illustrated in Text Sample 4.1 is sharply distinguished from modern academic writing, and especially different from modern science research writing.

We further show in the present chapter that eighteenth century science writing was not especially distinctive in its use of complex clausal embedding. Rather, most other eighteenth century written registers were similar in employing a complex grammatical style with extensive use of dependent clauses. Even fiction tended to be structurally elaborated, employing many of the same kinds of structures as in Text Sample 4.1. Thus consider the following passage from an eighteenth century novel written by Samuel Johnson:

Text Sample 4.2
Eighteenth century fiction

> The valley, wide and fruitful, **supplied** its inhabitants with the necessaries of life, and all delights and superfluities were **added** at the annual visit **[** which the Emperor **paid** his children, **[** when the iron gate was **opened** to the sound of music **]]**, and, during eight days, everyone **[** that **resided** in the valley **]** was **required** **[** to **propose** **[** whatever might **contribute** **[** to **make** seclusion pleasant **]**, **]]** **[** to **fill up** the vacancies of attention, and **lessen** the tediousness of time **]**. Every desire was immediately **granted**. All the artificers of pleasure were **called** **[** to **gladden** the festivity **]**: the musicians **exerted** the power of harmony, and the dancers **shewed** their activity before the princes, in hope **[** that they should **pass** their lives in this blissful captivity, **[** to which those only were **admitted** **[** whose performance was **thought** able **[** to **add** novelty to luxury **]]]]**.
>
> Samuel Johnson. 1759.
> 'Rasselas, Prince of Abyssinia'
> Cassell and Company, Limited.

This relative lack of variation among written registers in earlier centuries has been documented in multi-dimensional (MD) studies of historical register

variation. For example, Biber and Finegan (1997/2001, see Figures 4 and 5) show that fiction and academic research writing were quite similar linguistically in the seventeenth and eighteenth centuries with respect to 'Dimension 1: Involved vs. Informational Production'. In contrast, these two registers are sharply distinguished from each other at present. Comparisons like this show that there has been extensive register diversification that has taken place over the last three centuries. The obvious question is how this change came about, and what societal forces may have influenced the course of change. We consider two of these influences in the following section: the increasing preference for colloquial forms in writing ('popularization'), and the need to efficiently convey a great deal of information ('economy').

4.1.1 The influence of popularization versus economy in historical change

One of most widely noted linguistic developments that has occurred in English over the past two centuries has been the increasing use of colloquial linguistic forms in written registers. As we discussed in Chapter 1, researchers have given considerable attention to documenting the increased use of linguistic features associated with conversation in written registers. These features include first person pronouns, contractions, and semi-modals (e.g., *be going to, have to*). This trend, which has accelerated in the twentieth century, has been documented by discourse analysts and corpus linguists, and is referred to as the 'drift' of written registers towards more 'oral' styles (Biber and Finegan 1989a), 'informalization' (Fairclough 1992), and 'colloquialization' (Hundt and Mair 1999; Mair 2006; Leech et al. 2009).

Earlier investigations of these developments suggested that they represent a general historical trend affecting all written registers in English. However, subsequent investigations show that there are important differences among written registers, and as a result, some written registers have not fully participated in this historical shift. In particular, Biber and Finegan (1997/2001) show that written registers like fictional novels and personal letters have been strongly influenced by the shift to more colloquial linguistic styles, but written academic registers (science research articles and medical research articles) have not participated in these changes. Hundt and Mair (1999) also note this difference, distinguishing between 'agile' written registers (e.g., newspaper prose) that are receptive to these changes, versus 'up-tight' written registers (e.g., academic prose) that resist such changes.

However, it turns out that the actual patterns of historical change are more complicated than previously suspected. In particular, it is not accurate to describe academic prose as conservative and resistant to change. Rather, academic research writing has participated in alternative historical

linguistic changes, which are at least as important as the increased use of colloquial features documented for other written registers. These grammatical changes are completely different in kind. Thus, on the one hand it is accurate to portray academic writing as conservative because it has resisted the trend towards increased use of colloquial features. But at the same time, academic writing has been dynamic and innovative in its increased use of compressed structural devices, associated with 'economy' of expression (referred to as 'densification' in Leech et al. 2009).

The differences in the historical evolution of academic written registers versus other written registers can be interpreted relative to their underlying functional motivations, including social changes that have occurred over the past three centuries. On the one side are the influences of mass literacy and near-universal education, so that written texts are required for an increasingly wide readership. We refer to this influence as 'popularization' (see Biber 2003; Biber and Finegan 1989a). The general effect is to make writing accessible to the general public through adoption of a more informal style that employs features of conversation. At the same time, however, scientific research has been influenced by the opposite social force, so that academic sub-disciplines have proliferated and become increasingly specialized in topic, accessible only to restricted readerships. One underlying cause of this latter trend is the 'information explosion' and the need to present more information in an efficient and concise way; we refer to this factor as the need for greater 'economy' in written informational texts.

As we show in later sections, the linguistic innovations associated with economy in academic writing are at least as important as the shifts to colloquial styles witnessed in other written registers. The processes of popularization and colloquialization represent the spreading of existing linguistic patterns of use, from spoken discourse to writing. In contrast, we argue here that the historical developments towards increased economy in academic writing are more noteworthy, because they represent completely new linguistic styles of discourse not found in any register (spoken or written) in earlier historical periods.

The competing factors of popularization and economy have strongly influenced historical change in the grammatical characteristics of written texts over the past two centuries. As we show next, these factors correspond to different patterns of linguistic change: popularization is associated with the incorporation of colloquial features in written discourse, while economy is associated with the development of phrasal (rather than clausal) discourse styles. In particular, the historical processes associated with economy have affected the typical noun phrase structures found in

academic prose, and thus we turn to previous research on these structures in the following section.

4.1.2 Previous historical research on the noun phrase in English

One of the most salient linguistic characteristics of modern academic writing is its reliance on nominalizations and noun conversions. Nominalizations are nouns that have been morphologically derived from verbs (e.g., *development, progression*) or adjectives (e.g., *similarity, darkness*). 'Conversions' are verbs that come to be used as nouns, with no morphological additions (e.g., *increase, use*). Almost any sentence taken from a modern academic research article will illustrate the use of these features. For example, consider the opening sentences from three modern education research articles; derived nominalizations are **bold underlined** and converted nouns given in ***bold italics***:

> Now that programed **instruction** has emerged from the laboratories of experimental psychologists and become a bona fide teaching ***aid***, **consideration** is being given to the **expansion** and **utilization** of the media by which programs are presented.

> With the ***strain*** that increased **enrollments** are placing on the resources of many colleges and universities, these institutions are becoming more concerned with minimizing the **inefficiency** arising from student ***transfers***.

> This paper reports an **analysis** of Tucker's central **prediction** system model and an empirical **comparison** of it with two competing models.

In most cases, it is easy to restate this information using verbs and clauses. For example:

> *someone is considering the way in which the media has expanded and is being utilized*

> *students are transferring from colleges and enrolling in other colleges*

> *we analyzed a model that predicts systems, and compared it to other models*

However, in modern academic writing, it is common to use nominalized rather than verbal structures to express information of this type.

Halliday (2004: xvi–xvii) refers to this characteristic of academic writing as a heavy reliance on 'grammatical metaphor', where nominalizations are used to refer to the normal meanings associated with verbs ('processes') rather than the normal meanings associated with nouns ('entities'). Halliday (2004) provides examples to illustrate how discourse in written scientific prose exploits grammatical metaphor. For example, he contrasts alternative styles of expression, as in the following examples (Halliday 2004: 34):

1. *Glass cracks more quickly the harder you press on it.*
2. *Cracks in glass grow faster the more pressure is put on.*
3. *Glass crack growth is faster if greater stress is applied.*
4. *The rate of glass crack growth depends on the magnitude of the applied stress.*
5. *Glass crack growth rate is associated with applied stress magnitude.*

Halliday describes the first of these examples as the most 'congruent', where the meanings of words correspond to the expected meanings of the grammatical categories used. For example, the verbs *cracks* and *press* are used to refer to processes. In contrast, examples 4 and 5 illustrate a dense use of grammatical metaphor, with qualities and processes being expressed by nouns rather than adjectives and verbs. Halliday (1988; reprinted in Halliday 2004: chapter 5) has further claimed that science prose followed a historical progression similar to that illustrated in sentences 1–5 above. Illustrated with historical scientific texts written by Chaucer (1390), Newton (1704), and Priestley (1760s) – in contrast to modern science texts – Halliday argues that science prose has shifted historically from 'congruent' styles of expression to a dense reliance on 'grammatical metaphor'.

Although they have been influential, Halliday's contributions in this area have been primarily theoretical rather than empirical. That is, they have been fairly limited in the scope of the grammatical features considered, and they are not supported by a large-scale empirical analysis of historical texts. To address some of these concerns, Banks (2008) applies this theoretical framework to an empirical analysis of thirty science articles published in the *Philosophical Transactions of the Royal Society of London*. Banks's study shows that nominalizations have increased in use historically, in both the physical and the biological sciences (see Banks 2008: 124). Most of these nominalizations are used to refer to 'material processes' (e.g., *separation, emergence*), but 'mental processes' (e.g., *calculation*) and 'verbal [i.e., communicative] processes' (e.g., *description*) are also important (see Banks 2008: 125–130).

Halliday and Banks focus almost entirely on a single grammatical feature in academic writing: nominalizations. However, there is actually a suite of related grammatical features that are similar in that they present information through 'compressed' phrasal structures rather than through the use of verbs and clauses. For the most part, these features are noun phrase modifiers, and several recent studies have documented strong historical increases in the use of this wider array of grammatical features in academic writing (see, e.g., Biber and Clark 2002; Biber 2009; Biber and Conrad 2009; Biber and Gray 2010, 2013b; Leech et al. 2009). Five grammatical devices have been especially important in these discussions:

- nominalizations (e.g., *consumption, comparison, sustenance*),
- attributive adjectives (*gradually expanding cumulative effect*),
- nouns as nominal pre-modifiers (*baggage inspection procedures*),
- prepositional phrases as nominal post-modifiers (*a high incidence **of** heavy alcohol consumption **amongst** patients*),
- appositive noun phrases (*Dallas Salisbury, CEO of the Employee Benefit Research Institute*)

As noted earlier, nominalizations have been the most studied of these five devices. However, historical change in the use of the other grammatical devices is actually more noteworthy, because they represent features which are both more common overall, and which have witnessed much more dramatic increases in frequency over time. For example, we show that the historical increase for nouns as nominal pre-modifiers over the course of the twentieth century is much more important in these respects than the increased use of nominalizations.

These historical developments represent a fundamental shift in the discourse style of academic writing. These changes have resulted in grammatical patterns of use that are not attested in any register in earlier historical periods. However, they entail considerably more than just stylistic shifts in the density of nominal/phrasal features. Rather, the individual grammatical features have also undergone important extensions in their uses and functions. In the following sections and chapters, we explore these changes in detail.

4.2 General patterns of change in written English registers

Similar to the synchronic descriptions in Chapter 3, it is useful to employ a comparative register approach to highlight the distinctive historical patterns of change for academic research writing. That is, by comparing the change of grammatical characteristics in academic writing to the patterns of change in other general registers, it is possible to highlight the distinctive historical trajectory of that register. The present section thus compares the historical development of three general registers: fictional novels, news reportage (newspapers and magazines), and science research writing.

Historical change in the linguistic characteristics of written registers can be interpreted relative to the competing functional forces introduced in Section 4.1.1. On the one side are the influences of mass literacy and near-universal education. Because general literacy rates were low in the seventeenth and eighteenth centuries, written texts were addressed to a small readership. By the twentieth century, though, most adults in western

countries came to participate in formal education and thus developed relatively high standards of literacy. As a result, written registers like novels, newspapers, and magazines evolved to adopt linguistic styles that are accessible to this increasingly wide readership. In contrast, academic research writing has been influenced by the opposite forces over the last two centuries: the domain of academic research increased dramatically, accompanied by a proliferation of sub-disciplines that became increasingly specialized in both topic and readership. This 'information explosion' resulted in the need to present information in an efficient and concise way. As the present section shows, both of these major factors have influenced the linguistic development of English written registers over the last three centuries.

To track these patterns of change, we grouped texts into six general time periods: 1700–1800 (labeled '1750'), 1801–1870 (labeled '1850'), 1871–1919 (labeled '1900'), 1920–1949 (labeled '1930'), 1950–1979 (labeled '1960'), and 1980–2005 (labeled '1990'). We are interested primarily in change over the last century, and so we undertook more detailed sampling for those periods (see Chapter 2 for additional details on corpus design and composition).

Appendix 1 provides detailed descriptive statistics for several major grammatical characteristics, giving means and standard deviations for each linguistic feature in each register, across these historical periods. However, it can be difficult to determine the overall patterns of change from these detailed statistics.

Pearson correlations provide a more useful statistic for determining general historical trends. In the present case, we correlated the rate of occurrence for a linguistic feature in each text with the year of publication for those texts. Figure 4.1 illustrates the data used to compute these correlations, plotting the rate of occurrence for nouns in science research articles versus the year of publication (grouped into general historical periods) for each text.

Although there is variation among the texts within each historical period, Figure 4.1 shows a strong overall trend for an increased use of nouns in science writing across these historical periods. That trend corresponds to a strong correlation: $r = .77$. That is, correlations determine whether there is an association between the rate of occurrence of a linguistic feature and historical period, measuring both the extent and the direction of change for a linguistic feature in a register. Correlation coefficients have a scale of -1 to +1: a value near -1 represents a strong decrease in use over time; a value near +1 represents a strong increase in use over time; and a value near 0.0 indicates that there has not been any consistent pattern of change over time.

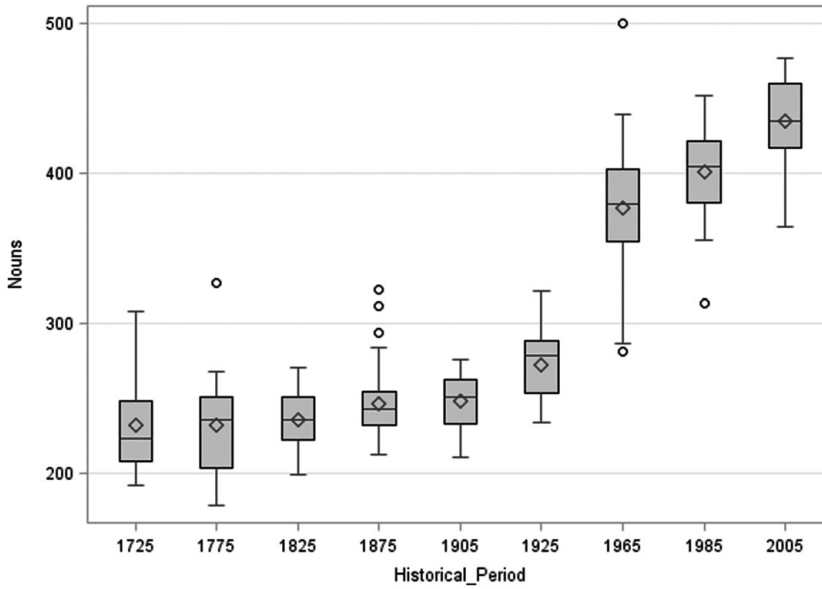


Figure 4.1 Distribution of nouns (per 1,000 words) across historical periods

Table 4.1 presents Pearson correlation coefficients for eight general linguistic characteristics, correlating the rate of occurrence for those features with historical period. The general historical trend shown by the correlation coefficient is also indicated: moderate increases in use are shown by + and stronger increases are shown by ++ or +++; decreases in use are shown by - and --.

Table 4.1 shows that each register has undergone distinct patterns of historical development over the past three centuries. In fiction, lexical verbs and adverbs have increased in use, while passive voice verbs, nominalizations, prepositional phrases, and relative clauses have all decreased in use. Overall, words have become shorter (corresponding to the large decrease in the use of nominalizations).

Science research writing has developed in exactly the opposite ways: lexical verbs and adverbs have decreased strongly over time, while nouns, adjectives, and nominalizations have increased in use. Words, on average, have become much longer over time in this register.

News reportage is intermediate between these two opposing trends, incorporating elements of both. Thus, lexical verbs and adverbs have increased in use (similar to fiction), but nouns and adjectives have also increased in use, and words have become longer overall (similar to academic writing).

Table 4.1 *Historical change in the use of general linguistic features, shown by Pearson correlation coefficients (r) for the rate of occurrence correlated with date (1750–1990)*

	Fiction N = 215 texts		News reportage N = 1140 texts		Science prose N = 524 texts	
	trend	***r***	**trend**	***r***	**trend**	***r***
Nouns		.17	++	.34	+++	.77
Lexical verbs	++	.33	+	.28	--	−.55
Adjectives		.01	++	.31	++	.37
Adverbs	++	.47	+	.25	--	−.58
Passive verbs	--	−.38	--	−.44		−.07
Nominalizations	--	−.55		.04	++	.48
Prepositional phrases	--	−.40	--	−.55	--	−.42
Average word length	--	−.32	+	.29	+++	.60

Key:
.60 to .99 = +++
.30 to .59 = ++
.20 to .29 = +
−.20 to −.29 = -
−.30 to −.59 = --

The increase in use for nouns in science prose is the strongest change shown in Table 4.1 (see also Figure 4.1). In contrast, fiction shows little change over time in the use of nouns (reflected by the correlation of only .17), while news reportage shows a moderate increase (r = .34). Nominalizations have also increased in science prose, but not nearly to the same extent as simple nouns (see Section 4.2.3). The frequency of nominalizations has remained essentially unchanged in news reportage, while there has been a strong decrease in use in fiction.

The historical trend for prepositional phrases – decreasing in all registers – requires further explanation. This trend appears to contradict our findings in Chapter 3, which singled out prepositional phrases as an important distinctive characteristic of modern academic research writing. The correlations reported in Table 4.1 are based on analysis of all prepositional phrases, including phrases functioning as adverbials and phrases functioning as noun modifiers. These phrases include both *of*-genitives and phrases with other prepositions. The findings in Chapter 3, however, show that the different types and functions of prepositional phrases have different register distributions. More specifically, the analysis in Chapter 3 showed that:

- Prepositional phrases functioning as adverbials are actually more common in modern fiction and news reportage than they are in modern academic prose (see Table 3.8).
- In contrast, prepositional phrases functioning as noun modifiers are considerably more common in modern academic prose than in other present-day written registers (see Table 3.8).
- There are complementary distributions for *of*-phrases versus other prepositions as noun modifiers across disciplines: *of*-phrases are more common in humanities academic prose than in the sciences, while other prepositional phrases are considerably more common as noun modifiers in the sciences (and social sciences) than in other disciplines (see Table 3.11).

It turns out that the overall decrease in use for prepositional phrases (shown by the negative Pearson correlations in Table 4.1) hides more interpretable patterns of increase and decrease for the specific types and syntactic functions. We thus return to a more detailed consideration of prepositional phrases in Section 4.2.3 .

Some of the historical trends in Table 4.1 are shared across registers. For example, words have become longer on average, especially in academic science prose, but also in news reportage. Passive voice verbs have decreased in use in all registers. This trend is strongest in fiction and news reportage. Surprisingly, the frequency of passive voice verbs has also decreased in academic science writing, although there has been only a slight change overall. This trend might be related to the more general drift towards colloquial styles, especially in fiction and news reportage. We thus turn to more detailed consideration of colloquial features in the following section.

4.2.1 Increasing use of colloquial features

As noted earlier, one of the most noticeable linguistic developments that has occurred in English over the past two centuries has been the increasing use of colloquial linguistic forms in written registers, such as contractions, semi-modals (e.g., *be going to, have to*), and even first person pronouns. In the last section, we documented historical trends for general grammatical characteristics associated with written discourse. In the present section, we shift our attention to the use of these colloquial features, demonstrating that the popularization of writing has had a major influence on general registers like fiction and news reportage. However, the corpus findings presented next show that academic prose has been little influenced by this trend.

Table 4.2 presents Pearson correlation coefficients for many of the most important colloquial features discussed in previous research, such as

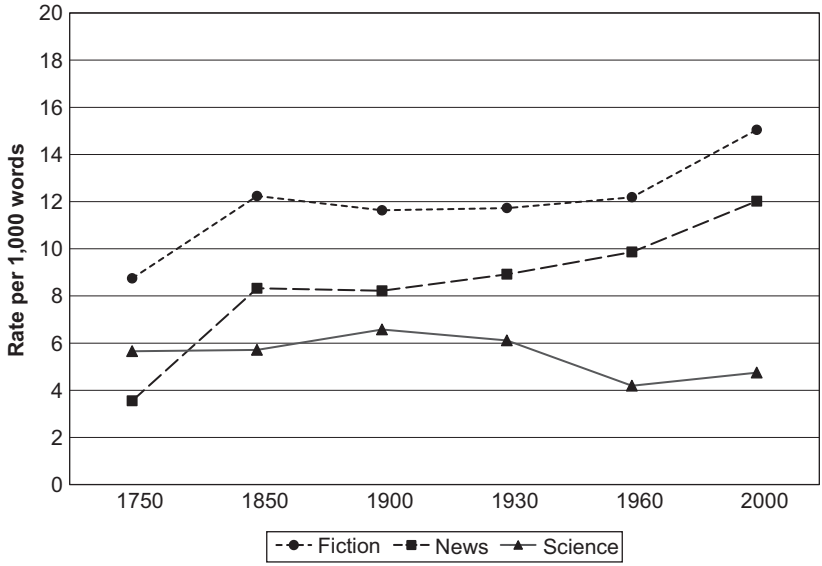


Figure 4.2 Historical change in the use of progressive aspect verbs

decreased in use ($r = -.44$). Similarly, bare infinitive constructions increased in use, while *to*-infinitives remained relatively unchanged in use over time.

As noted earlier, many of these features have also increased in use in news reportage, but the changes are much less pronounced than in fiction. Progressive aspect verbs provide a clear example of colloquialization affecting both fiction and news reportage (see also Leech et al. 2009: chapter 6). Figure 4.2 shows that news reportage lagged behind fiction in the use of progressives across centuries, but both registers follow the same general course, with an especially notable increase in use during the second half of the twentieth century. In contrast, science prose has changed little over the centuries in the use of progressive verbs, with a slight decrease in the twentieth century.

Table 4.2 further shows that complex progressives (i.e., perfect-progressives and progressive-passives) have generally increased in use. The overall frequencies for perfect-progressives are much lower than for simple progressives, but the historical development is quite similar: a gradual increase across the centuries, and a stronger increase during the twentieth century, with news reportage lagging behind fiction. Thus, perfect-progressives are moderately common in modern-day fiction and news reportage; for example:

Fiction:

People had been going about their business past those walls year after year.

News:

Richard Ramirez is a native of El Paso, Texas, who has been drifting around Los Angeles and San Francisco for several years.

Progressive-passives are a more interesting case, because their historical trend is the opposite of that for passive voice verbs generally. That is, in Section 4.2.1, we described how passive voice verbs have decreased in use in the twentieth century, especially in news reportage, but also in fiction and even in academic science prose. This decrease might be interpreted as a by-product of the overall trend towards increased colloquialization, by arguing that it reflects a dispreference for this stereotypically 'literate' feature.

However, in contrast to that general trend, progressive-passive verb phrases have increased in use in all three registers (although the actual frequencies are extremely low: less than 0.2 per 1,000 words). This trend can be interpreted as grammatical change in the use of progressive aspect, because it is recently coming to be used with passive voice. These verb phrases can occur in both finite and non-finite clauses; for example:

Finite clauses:

Fiction:

As a matter of fact, he was being punished.

News:

Policy papers are being prepared for the President.

Academic:

Three analytical approaches are being compared with the simulated data sets.

Non-finite clauses following a preposition:

Fiction:

They were instinctively aware of being watched.

News:

The looming threat of being kidnapped and murdered is crippling his ability to launch an adequate defense of the fallen dictator.

Academic:

Local assemblages within a region can show significant levels of nestedness despite being dominated by taxa with good powers of inter-locality dispersal.

Finally, first and second person pronouns have remained essentially unchanged over time in fiction and news reportage. Both types of pronouns were already common in fiction in the eighteenth century, and they have remained common up to the present time. In eighteenth century news reportage, first person pronouns were moderately common, while second person pronouns were rarely used; that pattern of use also persists up to the present day with little change. In contrast, academic prose has shown a marked decrease in the use of these pronouns. In the eighteenth century, first person pronouns were moderately common in academic writing, but they have become considerably less common in present-day academic texts. Second person pronouns were already rare in eighteenth century academic texts, and they have become even less frequently used over time.

In summary, the influence of colloquialization is strongest in popular written registers: written fiction has changed over the centuries to adopt an increased use of numerous conversational features. News reportage – a popular register with an informational focus – has undergone smaller changes towards increased use of these colloquial features. The strongest patterns for news reportage are for progressive verbs and passive voice verbs: progressives have increased notably in news reportage over the last century, while passive voice verbs have shown a strong decrease in use (compare Tables 4.1 and 4.2).

In contrast to the historical development of popular written registers, colloquialization has had little influence on the discourse style of academic prose, and thus these colloquial features are rarely used at present in that register. Overall, it is clear that colloquialization has been a major trend influencing historical change in written discourse over the past three centuries, but it has not applied uniformly to all written registers. As the following sections show, the opposing trend towards increased structural compression has been at least as important as a functional force influencing historical change in written discourse. However, that influence has operated in a complementary manner, affecting written academic registers to a much greater extent than popular written registers.

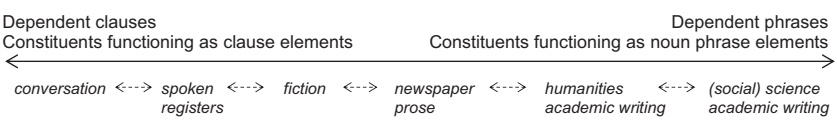
4.2.2 Historical change in the use of complexity features

In Chapter 3, we discussed the use of grammatical features associated with increased 'complexity' in various spoken and written registers. Two major grammatical oppositions were explored in that chapter:

– dependent clauses versus dependent phrases
– syntactic role as clause constituent/modifier versus noun modifier

The two parameters tend to go together when one is considering the grammatical structures that are most frequent in conversation versus academic writing. That is, conversation employs extensive clausal complexity, realized as a dense use of dependent clauses functioning as clause constituents (complement clauses) or clausal modifiers (adverbial clauses). In contrast, modern academic writing employs extensive phrasal complexity, realized as a dense use of embedded phrases functioning mostly as modifiers of a head noun.

In Chapter 3, we compared the use of these complexity devices across a range of present-day spoken and written registers. Those analyses show that it is not accurate to simply characterize a register as more or less complex. Rather, different registers employ different kinds of grammatical complexity. The most surprising finding from Chapter 3 is that clausal complexity – the focus of most previous research – is actually more characteristic of conversation and spoken registers than written registers. In contrast, the complexity of informational writing resides primarily in a dense use of embedded phrasal structures. Thus, the synchronic register comparisons from Chapter 3 can be summarized as a cline ranging from clausal to phrasal discourse styles:



The research question to be explored in the present section is how these different discourse styles developed historically. Table 4.3 presents Pearson correlations that measure historical change in the use of several of these complexity features in three general registers (fiction, news reportage, and academic prose).

The density of finite dependent clauses functioning as clause constituents has changed little in these registers over the past three centuries. Adverbial clauses and complement clauses have increased slightly in fiction and news reportage, and decreased slightly in academic prose (see the descriptive statistics in Appendix 1). However, the correlations reported

Table 4.3 *Historical change in the use of complexity features, shown by Pearson correlation coefficients (r) for the rate of occurrence correlated with date (1750–1990)*

	Fiction N = 215 texts		News reportage N = 1140 texts		Science prose N = 524 texts	
	trend	***r***	**trend**	***r***	**trend**	***r***
Dependent clauses						
Finite adverbial clauses		.13	+	.24	-	−.22
Finite complement clauses		.16		.12		−.15
Relative clauses (total)	--	−.47		−.05	--	−.61
NP clausal post-modifiers						
WH-relative clauses	--	−.50	--	−.35	---	−.62
That relative clauses		.02	++	.42		−.06
Non-finite *-ing* relatives	--	−.36	--	−.38	--	−.36
Non-finite *-ed* relatives		.06		−.15		.09
That noun complement clauses	+	.25		.04	+	.24
To noun complement clauses		−.13		.14		−.11
Of + *-ing* clause		−.12		−.10		−.12
Other preposition + *-ing* clause		−.09		−.01		.16
NP phrasal pre-modifiers						
attributive adjectives	-	−.25		.09	+	.29
Nouns as nominal pre-modifiers	++	.51	++	.53	+++	.75
N-xx*ing* as pre-modifiers	+	.22		.12	+	.28
N-xx*ed* as pre-modifiers	+	.26	+	.21	++	.33
NP phrasal post-modifiers*						
of-phrases as post-modifiers	--	−.47	--	−.57	-	−.20
in-phrases as post-modifiers	+	.26		.17	+++	.60
on-phrases as post-modifiers	++	.43	+	.20	++	.41
for-phrases as post-modifiers		−.10		.11	+++	.60
with-phrases as post-modifiers		−.02	+	.29		.13

Key:
.60 to .99 = +++
.30 to .59 = ++
.20 to .29 = +
−.20 to −.29 = -
−.30 to −.59 = --
−.60 to −.99 = ---

* These findings regarding the distribution of prepositional phrases are based on hand-coding of twenty texts from each sub-register for 1850–1985. We identified only prepositions that immediately followed a noun, considering all occurrences for less common prepositions (*for* and *with*) and sampling from across the text for more common prepositions (*in* and *on*). Then, each prepositional phrase was coded by hand to determine whether it was functioning as an adverbial or noun modifier. The rates of occurrence for each text were then extrapolated, based on the overall counts for those prepositions in the texts.

in Table 4.3 are small, showing that there has been little systematic change in the use of those clause types.[1]

In contrast, our results show a relatively strong decrease in the use of relative clauses, especially in fiction and academic research writing. (The overall frequency of relative clauses in news reportage has remained essentially unchanged.) This finding is surprising, because relative clauses have been regarded as one of the major indicators of complex academic writing. Upon closer inspection, it becomes clear that the overall decrease in use is due mostly to a large decline in the frequency of *WH*-relative clauses (see also Hinrichs et al. to appear). *That* relative clauses have increased moderately in news reportage (especially in American English), but they are less frequent than *WH*-relative clauses in absolute terms, and their density of use has remained unchanged in fiction and academic prose. Non-finite relative clauses show a similar pattern: *-ing* clauses have decreased in use in all three registers, while *-ed* clauses have remained essentially unchanged in their density of use. Noun complement clauses have also changed little in their overall density of use: *that* noun complement clauses have increased slightly in fiction and academic prose, but *to*-clauses and *-ing* clauses have remained essentially unchanged in their density of use. Taken together, these trends reflect an overall decline in the reliance on clausal subordination; this decline has been by far most pronounced in academic prose, but it has to some extent affected all written registers.

Thus, written discourse has certainly not become more 'complex' over the last three centuries in terms of its reliance on dependent clause structures. In fact, to the extent that there has been change in the use of these features, the trend has been towards decreased use. To some extent, that trend has influenced all written registers, but it has been strongest in academic writing.

In contrast, phrasal modifiers of noun phrases have generally increased in use, with very strong increases found for some features; those increases have been most pronounced in academic research writing. This pattern

[1] There have, however, been important changes in sentence style over the past three centuries, with sentences in eighteenth century prose often being very long, with multiple dependent clauses. Further, eighteenth century written prose differed from twentieth century prose by incorporating the full inventory of dependent clause types, including finite and non-finite clauses in all syntactic functions. Thus, while the overall density of dependent clauses in texts has changed little over the past three centuries, there has been a striking evolution in sentence style (contrast text Samples 4.1 and 4.2 with the text samples found in Chapter 3).

exists for both nominal pre-modifiers and nominal post-modifiers. Among the pre-modifiers, nouns as nominal pre-modifiers were relatively rare in the nineteenth century, but they have steadily increased in use over the subsequent decades (see Section 4.2.3). This change occurred in all three written registers, but there has been an especially large increase in academic prose (shown by the large positive correlation of .75). Pre-modifying nouns that are further post-modified by a participle (e.g., *law-making powers, age-related change*) are not frequent in absolute terms, but they have increased in use in all registers. Attributive adjectives are the only exception to the increased use of phrasal noun pre-modifiers: this feature was already common in all three written registers in the nineteenth century, and it has continued to be common (i.e., with little change in frequency) up to the present day.

In contrast to the decline seen for relative clause constructions, phrasal post-modifiers of a head noun have generally increased in use over the last three centuries. That increase has been especially strong in academic prose, but Table 4.3 shows that it has also occurred to a lesser extent in fiction and news reportage. The affected features here include prepositional phrases as noun modifiers as well as appositive noun phrases (see Figure 4.10).

The one exception to this general trend is post-nominal *of*-phrases. Similar to attributive adjectives, *of*-genitive phrases were already well established and frequent by the eighteenth century, and they have not increased in use since then. In fact, this structure decreased in use in all three written registers over the last century (although *of*-phrases are still common in academic writing – see 4.2.3).

In contrast, other prepositions as post-nominal modifiers were rare in the nineteenth century, but have shown strong increases in use, especially during the twentieth century. Table 4.3 shows the correlations for *in, on, for*, and *with* phrases. The increases in use are strong in academic writing (see especially the large positive correlations for *in, on*, and *for* phrases), and moderately strong in news reportage. However, even fiction shows relatively large increases in use for *in* and *on* as post-nominal modifiers.

In summary, two major patterns are evident from Table 4.3. First, the most important historical changes for complexity features have occurred with phrasal rather than clausal grammatical features. Phrasal noun modifiers that were already well-established by 1800 – attributive adjectives and post-nominal *of*-phrases – did not participate in this historical trend

(and *of*-phrases have actually decreased in use.) But many other types of phrasal noun modifiers were just becoming established in the eighteenth century, and these features have all undergone large increases in use over the subsequent decades.

Second, although these historical changes have affected all written registers, they have been most important in the informational registers; the changes have been most pronounced in academic writing, with news reportage also undergoing large increases in the use of these features. The most important functional motivation for these changes is apparently an informational purpose (characteristic to some extent of both news reportage and academic writing), with an expert/specialized readership being a secondary factor (in academic writing). In addition, some of these changes that were initiated in informational writing have subsequently been adopted in other written registers; thus, popular written registers like fiction have undergone many of these changes to a lesser extent. However, as shown in Chapter 3, these features remain especially characteristic of informational written discourse, while all of these features are extremely rare in present-day conversation and other spoken registers.

4.2.3 *Exploring the magnitude of change: The evolution of a phrasal discourse style*

The preceding sections use correlation coefficients to track systematic linguistic changes across historical periods. Specifically, we computed rates of occurrence for each linguistic feature in each text, and then used Pearson correlations to measure the extent to which there have been systematic increases/decreases in those rates across historical periods. Those analyses show that phrasal structural devices functioning as noun phrase modifiers have increased in use over time, while dependent clauses have declined in use, even when they function as noun modifiers (i.e., relative clauses).

One limitation of correlational statistics is that they do not indicate the overall frequency of a feature or the magnitude of change. So, for example, an increase from 2 to 4 to 6 occurrences (per 1,000 words) across historical periods would result in a similar positive correlation as an increase from 100 to 200 to 300 occurrences (per 1,000 words) across periods. Similarly, a larger correlation for a feature in a register does not necessarily mean that the feature is more frequent in that register. So, for example, an increase

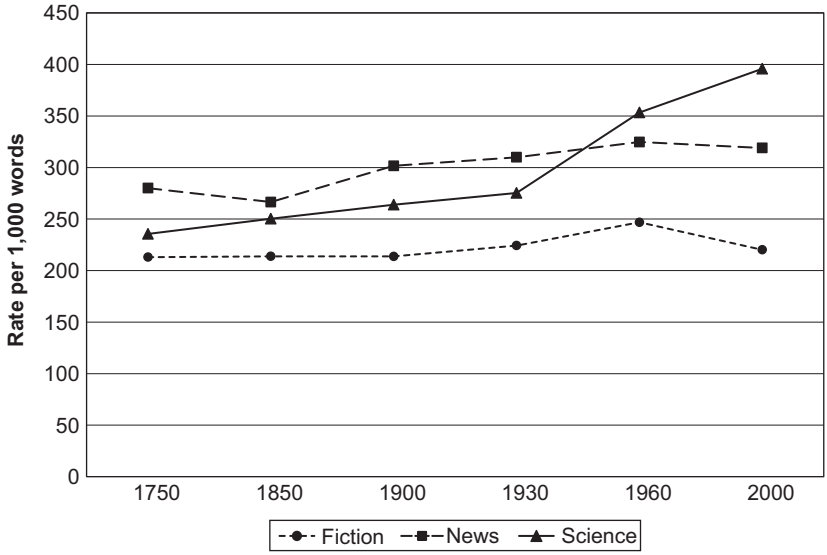


Figure 4.3 Historical change in the use of nouns

from 2 to 4 to 6 occurrences (per 1,000 words) across historical periods would result in a positive correlation in Register A, while a decrease from 300 to 200 to 100 occurrences (per 1,000 words) would result in a negative correlation in Register B – even though the actual rate of occurrence for the feature is much higher in Register B. Thus, from a textual perspective, the overall frequency and the magnitude of change must also be considered to fully document historical developments.

A second limitation of Pearson correlations for the analysis of historical change is that they capture linear developments. However, the actual pattern of change for many of these features has not been linear. Rather, there have been gradual patterns of change across the eighteenth and nineteenth centuries, followed by much more dramatic shifts in the patterns of use in the twentieth century.

For example, Figure 4.3 plots historical change in the density of common nouns in three general registers, corresponding to the correlation coefficients given in Table 4.1. Figure 4.3 shows that nouns are relatively common in fiction, but their rate of occurrence has changed little over these historical periods (r = .17 in Table 4.1). Nouns are more frequent overall in news reportage, and there has been a more consistent increase in use over time, although that change has not been especially strong (r = .34 in Table 4.1).

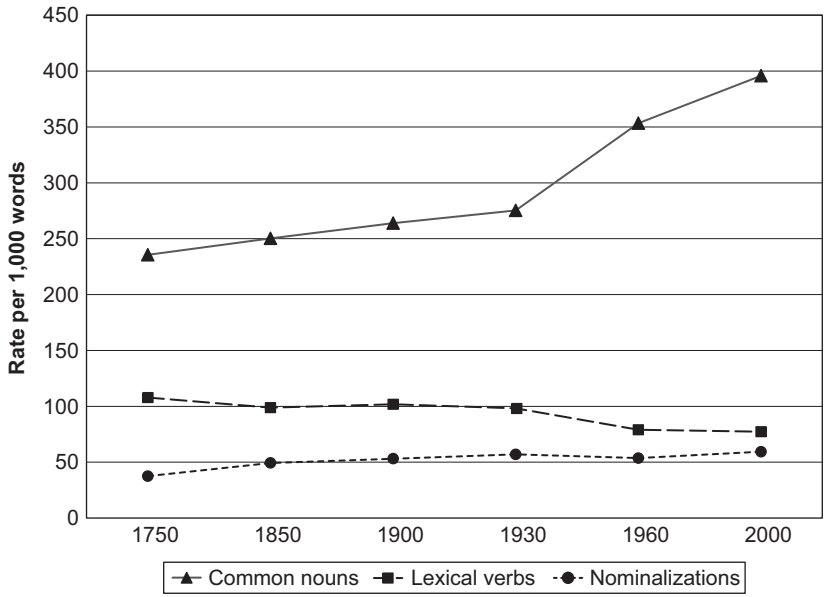


Figure 4.4 Historical change in science research writing: common nouns, nominalizations, and verbs

In contrast, we can see from Figure 4.3 that nouns were actually less frequent in science writing than in news reportage during the eighteenth and nineteenth centuries. However, that relationship changed dramatically over the course of the twentieth century. The historical change in the use of nouns in academic science writing is non-linear: a gradual increase in use during the eighteenth and nineteenth centuries, followed by a rapid increase in use during the twentieth century. As a result, nouns are currently much more frequent in science writing than in either of these other two registers.

We noted in Chapter 3 that nominalizations have been singled out as one of the most distinctive linguistic characteristics of scientific writing (see, e.g., Halliday 2004; Banks 2008). However, Figure 4.4 shows that common nouns are much more frequent than nominalizations in science prose. In addition, Figure 4.4 shows that nominalizations have undergone only a gradual linear increase in use over time, while common nouns have rapidly accelerated in use during the twentieth century. As a result, common nouns are eight times more frequent than nominalizations in present-day science research writing. (Figure 4.3 also shows that lexical

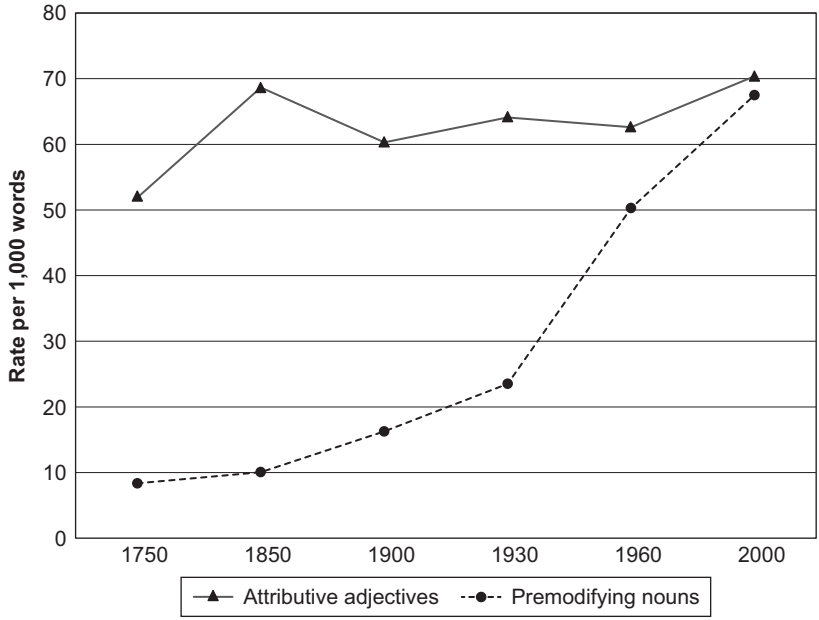


Figure 4.5 Historical change in the use of noun phrase pre-modifier types in academic prose: attributive adjectives versus nouns as pre-modifiers

verbs have been gradually decreasing in use in academic research writing over the past three centuries; we further discuss this trend next.)

In modern science writing, many of these nouns function as nominal pre-modifiers (e.g., *sea level change)*. However, Figure 4.5 shows that was not always the case. In fact, pre-modifying nouns were rare up until the twentieth century. However, at that point there was a large increase in use in academic prose. The historical shift begins at the turn of the twentieth century, and then rapidly takes off in the mid-twentieth century, continuing to increase in use right up to the present time. In contrast, attributive adjectives were already common as noun modifiers in the eighteenth century, and they have continued to be common up to the present day, with little change.

In Chapter 3, we described the use of a highly specialized structure found in late-twentieth-century academic research writing: noun-participle compounds functioning as nominal pre-modifiers (e.g., *accountability-based reform efforts, decision-making practices*). As Figure 4.6 shows, this structural device was rarely used throughout the eighteenth and nineteenth centuries, with little change in use even through the first half of the

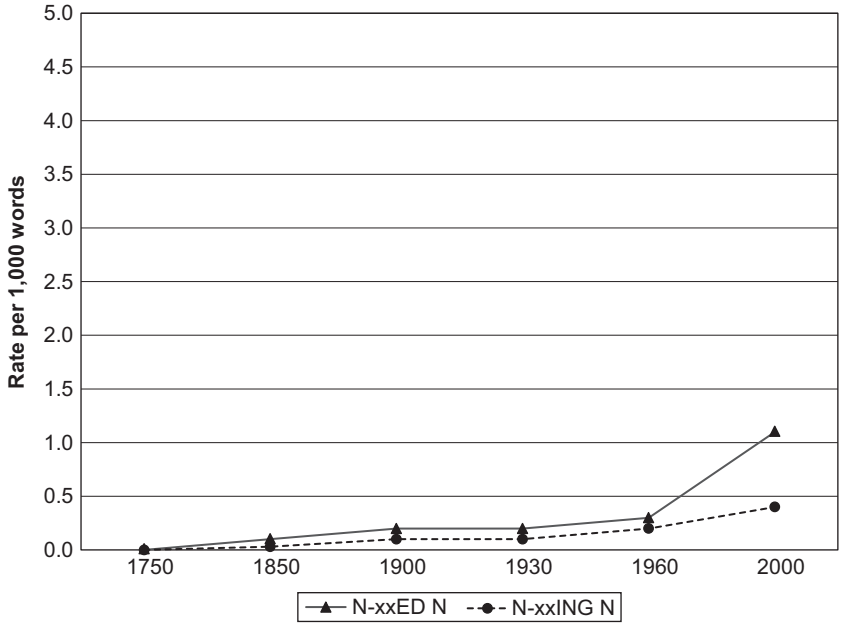


Figure 4.6 Historical change in the use of emerging NP pre-modifier types in academic prose: N-XX*ing* + N and N-XX*ed* + N

twentieth century. However, in recent decades, these devices have come to be used with increasing frequency. This is especially true for N-*ed* + N constructions, which have increased in use by a factor of 4 over the last 50 years. However, N-*ing* + N constructions have also more than doubled in that period. Neither of these features is especially frequent in absolute terms, but they are both showing rapid recent increase in use, with no signs of a leveling off in those trends.

Two other structural devices that function as post-nominal modifiers have actually decreased in use over the past three centuries: relative clauses and *of*-phrases. Figure 4.7 shows that relative clauses were common in all written registers in the eighteenth century, reflecting the generally elaborated style of written discourse typical of that period (see Section 4.1). The frequency of use declined during the nineteenth century, and then remained relatively stable up through the early twentieth century. Over those historical periods, relative clauses were moderately frequent in news reportage and academic prose, while fiction evolved to employ a less elaborated style, with fewer relative clause constructions. In the second half of the twentieth century,

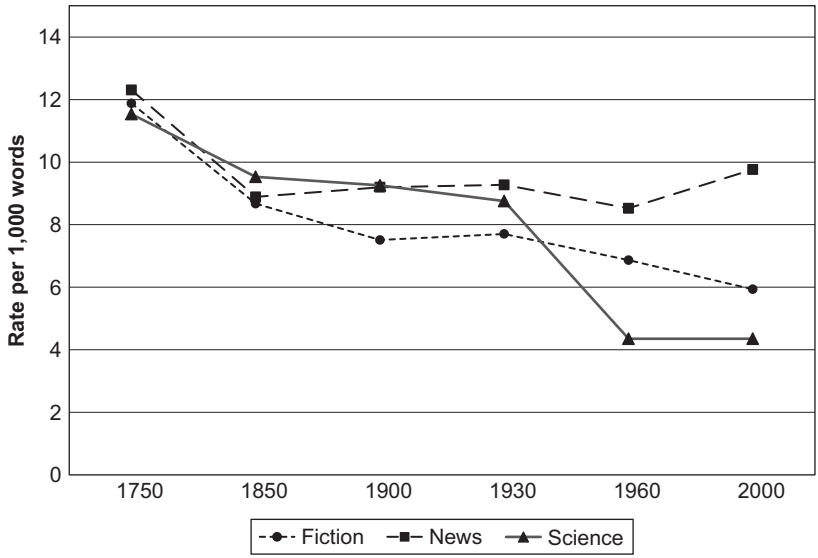


Figure 4.7 Historical change in the use of finite relative clauses

relative clauses continued to decline gradually in fiction (reflecting the general shift towards more colloquial styles), while they have remained essentially constant in use in news reportage. However, the most notable change here occurred in academic research writing, which has undergone a dramatic reduction in the use of relative clauses over the last fifty years.

We noted in the discussion of Table 4.2 the surprising historical decline for prepositional phrases in academic prose. However, there are different structural types of prepositional phrases (especially the *of*-genitive versus other prepositional phrases), and those structures can serve adverbial versus noun-modifying syntactic functions. Figure 4.8 shows that these grammatical differences are important for understanding the actual patterns of historical change: in science writing, there has been a sharp decrease in use for prepositional phrases functioning as adverbials, and a similarly strong decline for *of*-phrases functioning as noun modifiers; however, there has been an equally strong *increase* in use for other prepositional phrases functioning as noun modifiers. As a result, sentences like the following are common in present-day academic prose:

> *Specifically, we were interested in the qualitative ecological difference in emphasis between changes in composition vs. changes in relative abundance.*

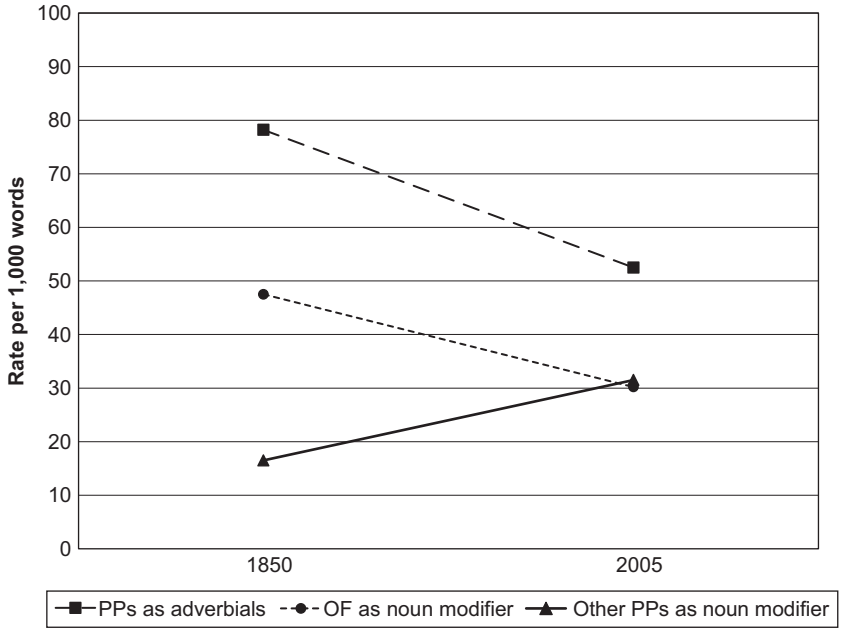


Figure 4.8 Historical change in the distribution and functions of prepositional phrases in science academic prose

Figure 4.9 traces the development of four individual prepositions functioning as noun modifiers: *in, on, for, with*. Although none of these prepositions is especially frequent by itself, they have all been increasing steadily over the last 100 years. Similar increases can be observed for many other prepositions that head post-nominal phrases. Taken together, these 'other' prepositional phrases functioning as noun modifiers have become as common as *of*-phrases in modern science prose. However, there are signs that this historical trend is leveling off, especially when considered relative to the full suite of other structural devices used for nominal modification. We return to that comparative perspective in Chapter 5.

Appositive noun phrases are another phrasal device used for noun modification. In Chapter 3, we discussed the frequent use of this structural device in twentieth century news reportage and academic research writing. Historically, these structures date back to Middle English (see Nevalinna and Pahta 1997; Pahta and Nevalinna 1997), but they were relatively rare in the eighteenth and nineteenth centuries. However, as Figure 4.10 shows, appositive noun phrases have become considerably more common in the twentieth century.

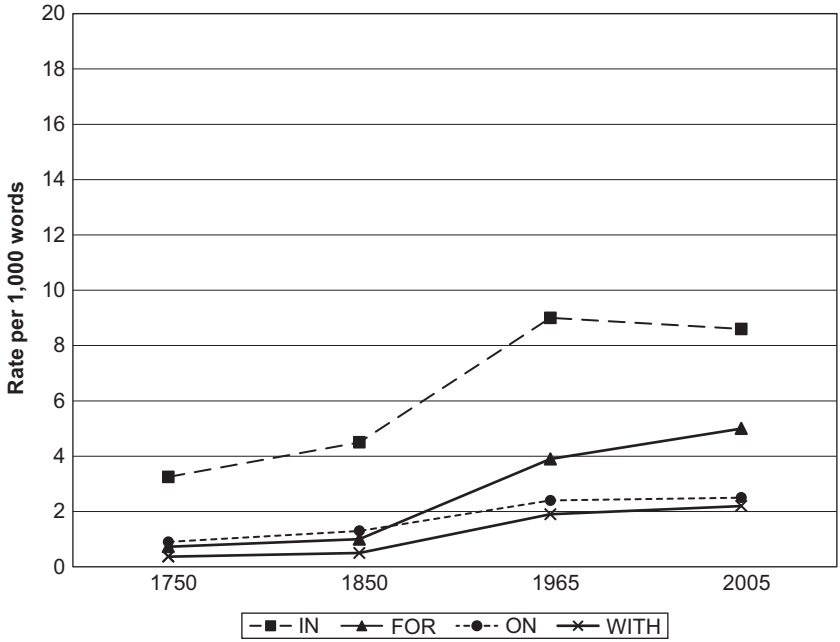


Figure 4.9 Historical change in the distribution of specific prepositional phrases functioning as noun modifiers in science academic prose

The typical function of appositive noun phrases in earlier centuries was to add descriptive information about a human head noun. This function was common in both news reportage and academic prose, and it continues to be one of the primary uses in twentieth century news reportage:

Eighteenth century newspaper:

> *About ten days ago Sir George Benham, **the Governor of Hong Kong**, received a message. . .*

Eighteenth century science prose:

> *A post-mortem examination was made by Dr. C.W. Swan, **pathologist to the city hospital**. . .*

In the nineteenth century, a structural/textual innovation was introduced in science writing: the use of parentheses to mark the appositive noun phrase, rather than separating the two noun phrases by commas. For example:

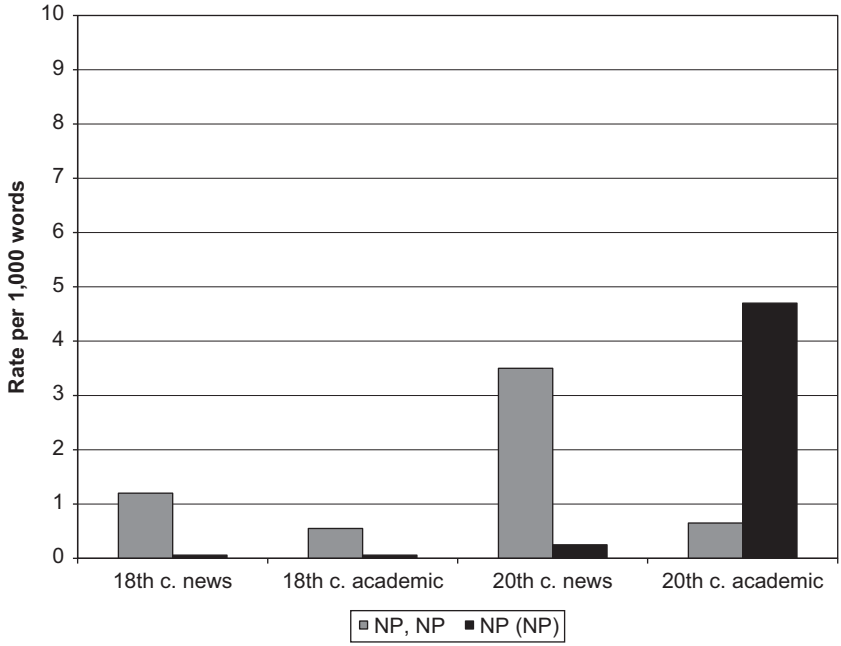


Figure 4.10 Appositive noun phrases as nominal post-modifiers

*In about two months after it had acquired this additional head, a fragment separated from the tail (**the most usual place of separation**) and was in progress towards its entire reproduction when it was accidentally lost . . .*

*the former is composed of sporules, empty tubes (**the mycelium**), and tubes filled with sporules*

As Figure 4.10 shows, this textual device has become quite common in the twentieth century, but it is restricted almost entirely to science research writing.

In this section, we have considered the magnitude of historical change in the use of the phrasal devices that function as noun modifiers, by examining the overall frequency of those features in academic science writing. This analysis provides a complementary perspective to the correlational analyses presented in Sections 4.3.1–4.3.3 (which measure the extent to which change has been systematic). The analyses in the present section have shown that most of these phrasal noun modifers are extremely frequent in academic texts, and that they have increased in use dramatically during the twentieth century.

4.3 What features have decreased in use in academic prose?

Given the strong historical increase in the use of nouns and phrasal noun-modifying structures in academic prose, it is natural to wonder what features have decreased in use. The quantitative findings presented in Figures 4.3–4.10 are rates of occurrence per 1,000 words of text. So, if one feature increases in use, other features must decrease in use by the same amount. For example, Figure 4.4 shows that nouns in science writing increased in use during the twentieth century by about 125 per 1,000 words. Thus, if we were to compare 1,000-word samples from different historical periods, we would find the following: in a 1900 science research article, 265 of those words were nouns, while the rate for nouns rose to almost 400 of the 1,000 word sample in research articles published in 2000. These rates can be interpreted in a mechanical way: In a typical nineteenth century science text, c. 25% of the words were nouns, while in a typical twenty-first century science text, c. 40% of the words were nouns. Thus, an additional 15% of a typical present-day science text is realized as nouns.

As a result, other features must be used less commonly, to make room for the additional nouns. One obvious choice might be verbs: as the density of nouns goes up, we might expect the density of verbs to go down. Figure 4.4 shows that the direction of change for lexical verbs in science prose is as predicted, but not the magnitude of that change. That is, lexical verbs have decreased in use by only c. 20 per 1,000 words (or only by c. 2% of the text).

However, Tables 4.2 and 4.3 show that there have been several other grammatical features that have decreased in use in science prose, including adverbs, pronouns, and prepositions. It turns out that some of these changes have been relatively large in magnitude. For example, Figure 4.8 shows that adverbial prepositional phrases have decreased by almost 30 per 1,000 words over the last century, and *of*-phrases have decreased by almost 20 per 1,000 words. Table 4.3 shows a large negative correlation for third person pronouns in academic prose. That correlation corresponds to a dramatic decline in the frequency of third person pronouns, from a rate of c. 20 per 1,000 words in the eighteenth century to a miniscule rate of only 2–3 per 1,000 words in the late twentieth century.

In addition, other features have dramatically declined in use but escaped the notice of previous analysts. One of the most surprising changes in academic discourse style is a strong decrease in the use of definite articles (and determiners generally). We expected that determiners would increase in use, accompanying the strong increase in nouns in science writing. However, the actual historical development has been exactly the opposite,

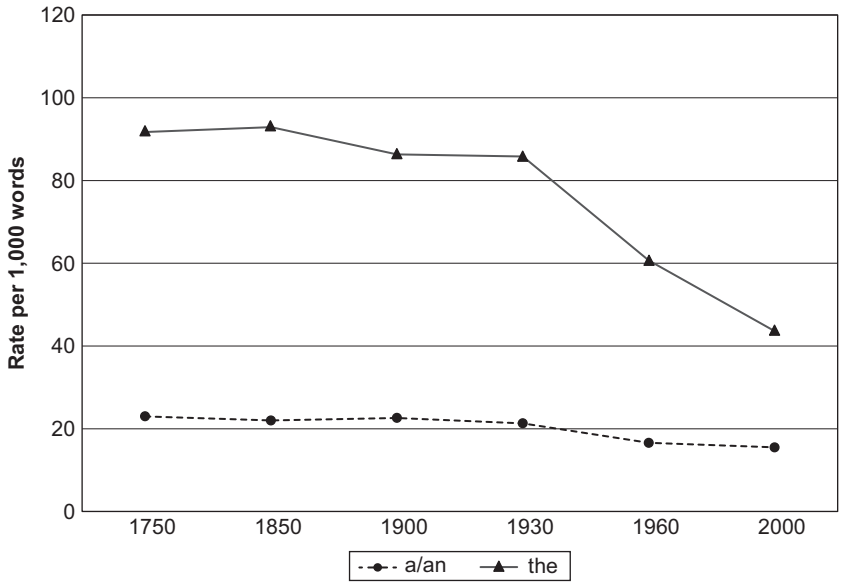


Figure 4.11 Historical change in the use of definite and indefinite articles in science academic prose

as shown in Figure 4.11. Indefinite article use has been declining gradually over the past century. But the dramatic shift here is for definite articles, which were slowly declining over the course of the nineteenth century, and then declined dramatically in the second half of the twentieth century.

This reduction in definite article use has several sources, including a greater use of abstract process nouns and technical nouns (with a function similar to proper nouns, which typically occur without determiners). The use of abstract/process or technical head nouns without determiners was already prevalent in nineteenth century science writing, as in Text Sample 4.3. For example, nouns like *neutralization* and *dyeing* refer to processes and thus do not normally take a determiner, while nouns like *hydrate, alumina*, *magnesia*, *carbonate*, and *lead* are essentially proper nouns.

Text Sample 4.3
Nineteenth century science research writing

Definite articles are marked in *italics;* noun phrases with no determiner are **bold underlined**.

By adding a variety of **substances** to an extract of **madder** with **cold water**, I was enabled to ascertain under what circumstances and by

what means *the* tinctorial power of *the* liquid is destroyed, and consequently what is *the* general character of *the* substance or substances to which it is due. I found that by adding sulphuric or muriatic **acid** to *the* extract and heating, *the* liquid, after **neutralization** of *the* acid was no longer capable of **dyeing**. *The* tinctorial power was also destroyed by *the* addition of **hydrate** of **alumina, magnesia, protoxide** of **tin** and various metallic **oxides**, but not by **carbonate** of **lime** or **carbonate** of **lead**. In all cases in which *the* property of **dyeing** in *the* extract was destroyed, I invariably found that its bitter taste and bright yellow colour were lost.

Edward Schunck. 1851.
'On Rubian and Its Products of Decomposition'
Philosophical Transactions, 141, 433–459.

These same types of nouns occur even more frequently without determiners in present-day academic prose. For example, Text Sample 4.4 illustrates the dense use of process nouns (e.g., *selection, reproduction, growth*) and other abstract nouns without determiners (e.g., *synchrony, variation, phenology, predictability, constancy*).

Text Sample 4.4
Twentieth century science research writing

Definite articles are marked in *italics;* noun phrases with no determiner are **bold underlined**.

Summary

1. **Timing** and **synchrony** of **reproduction** are regarded as crucially important **factors** for **fitness** in seasonal **environments**. Natural **selection** has probably favoured temperate and arctic **female herbivores** that match **reproduction** with **onset** of **plant growth** in **spring**. However, **breeding synchrony** may also be affected by **variation** in phenotypic **quality** of **females** in a population, because **females** in poor **body condition** have been found to delay **ovulation** and subsequent **calving**.
2. We compared **breeding phenology**, i.e. *the* timing and synchrony of **rutting** (**roaring**, sexual **aggregation**) and **calving** of red **deer** (**Cervus elaphus L.**) in **France** (**latitude**: 49°N) and **Norway** (**latitude**: 63°N). We hypothesized (H1) that **calving** and **rutting** were later at *the* site with latest **onset** of **plant growth**.
3. We further quantified overall environmental **predictability** as *the* sum of annual **constancy** and **seasonality** and tested three different (not mutually exclusive) hypotheses about **breeding synchrony**: (**H2a**) *the* population experiencing most seasonal **plant phenology** should show *the* highest breeding synchrony; (**H2b**) overall **predictability** of **plant phenology** should determine **breeding**

> **synchrony**; and (**H2c**) **breeding** should be more synchronized in *the* population with lowest **female body weight variation** within **age classes** because they ovulate more synchronously.
>
> L.E. Loe et al. 2005.
> 'Climate Predictability and Breeding Phenology in Red Deer:
> Timing and Synchrony of Rutting and Calving in Norway and France'
> *Journal of Animal Ecology*, 74: 579–588.

In addition, there has been a shift to omit definite articles even for noun phrases that can be regarded as specific in reference, apparently to generalize the reference to a whole population rather than the specific objects considered in a particular study. Such factors can help to explain the absence of the definite article in phrases like:

> ***the*** site with Ø latest onset of plant growth
>
> ***the*** population experiencing Ø most seasonal plant phenology
>
> Ø overall predictability of plant phenology should determine breeding synchrony
>
> ***the*** population with Ø lowest female body weight variation within age classes

Thus, the increased use of nominal/phrasal structures in academic writing has been offset by decreases in a range of other devices. These include features that are clearly complementary to noun phrase structures, such as lexical verbs, auxiliary verbs, pronouns, and adverbs. But more surprisingly, the features that have declined in use also include prepositions (especially *of* and also other prepositions functioning as heads of adverbial phrases) as well as determiners. We return to more detailed discussions of these developments in Chapters 5 and 6.

4.4 Historical change across sub-registers within academic research writing

One primary goal in this book is to highlight the importance of academic prose for historical linguistic research, because it has been so innovative in the development and use of phrasal modifiers. These changes are much more pronounced in academic writing than in most other registers of English, directly contradicting the stereotypical view that academic writing is resistant to grammatical change.

The changes in discourse style documented in the preceding sections have been rapid historical developments, occurring mostly in the twentieth century. However, as we showed in Chapter 3, different sub-registers within present-day academic writing differ in the extent to which they

exhibit these characteristics: academic research articles employ greater structural compression than university textbooks; science research articles employ greater structural compression than humanities research writing; specialist science research articles employ greater structural compression than popular science articles.

In the present section, we track the historical evolution of such differences, showing how sub-registers of academic prose have become increasingly diversified over the course of the twentieth century. In particular, we compare the historical development of four specific academic sub-registers: specialist science research articles, popular multi-disciplinary science research articles, social science research articles, and humanities articles/books.

In the eighteenth and nineteenth centuries, these differences were less important: social science was not well-established as a separate discipline; there were relatively few well-established sub-disciplines of science; and most science writing was directed towards a multi-disciplinary readership (see discussion in the following paragraphs). Thus, for our analyses in this section, we distinguish between only two general nineteenth century sub-registers of academic prose: multi-disciplinary science research articles and humanities books (history). In contrast, disciplinary differences become much more important in the twentieth century. As a result, we include a more specific sampling of academic sub-registers for the twentieth century, with texts from specialist science research articles, popular multi-disciplinary science research articles, social science research articles, and humanities (history) articles/books. A full description of these sub-corpora is provided in Chapter 2, Section 2.3.

The comparison of specialist versus generalist multi-disciplinary science writing requires some background discussion. Some of the science research journals that were influential in the eighteenth and nineteenth centuries have continued to publish research articles up to the present day. For example, the *Philosophical Transactions of the Royal Society* (*PT*) has been published continuously since 1665, and the journal *Science* has published research articles since 1880. As a result, previous studies have tracked linguistic change in English science writing through consideration of these influential research journals (see, e.g., Biber, Finegan, and Atkinson 1994; Atkinson 1996; Biber and Finegan 1997/2001; Valle 1999; Gross et al. 2002). In many ways, these journals have remained relatively constant in purpose and readership, intended as outlets for the most important science research findings from across the full range of scientific disciplines, and written for an audience from that same breadth of disciplines. By basing historical analyses on a single research journal, which has remained

relatively constant in purpose and readership across time, researchers have been able to isolate the influence of historical change (i.e., minimizing any confounding influence that would result from comparisons of different academic journals).

However, an additional consideration is the role of the targeted research journal relative to the universe of academic research writing in a given historical period. Thus, in the eighteenth and nineteenth centuries, most science writing was published in a relatively small number of multi-disciplinary journals, and read by a wide multi-disciplinary audience. Research articles published in journals like *PT* and *Science* provide a fairly good representation of the universe of science writing from those periods. In contrast, there has been an incredible proliferation of academic research journals in the last half of the twentieth century, and as a result, generalist journals like *PT* and *Science* represent only a very small sector of present-day science writing. Most science writing today is published in highly specialized journals associated with specific sub-disciplines, and read mostly by specialists from those same sub-disciplines. As we show next, this difference actually has important linguistic consequences: science research articles published in specialist research journals from a specific sub-discipline turn out to be quite different grammatically from articles published for a more general readership in multi-disciplinary journals like *PT* and *Science*. And as a result, the dramatic historical changes towards increased use of compressed phrasal devices is considerably more pronounced in specialist science research writing than in any other register.

As the preceding analyses have shown, one of the most salient grammatical characteristics of modern academic writing is the heavy reliance on nouns. Figure 4.3 shows that the density of common nouns has been increasing steadily in academic writing over the past 200 years, with a more rapid increase during the twentieth century. This shift towards a more "nominal" style was noticed as early as 1960 by Wells. However, the fact that this is an ongoing change, which has intensified in the last half of the twentieth century, means that Wells's observations in the 1960s represent a density of nominal use that is considerably less extreme than in present-day academic research writing!

Figure 4.12 shows that academic sub-registers have participated in this change to differing extents. In particular, history research writing has changed little over this period: it had a relatively dense use of nouns in the nineteenth century, and it has maintained roughly that same density of nouns up to the present time. In contrast, the use of nouns has increased dramatically in science research writing, and it appears that the increase is still in progress. The trend is by far most evident in

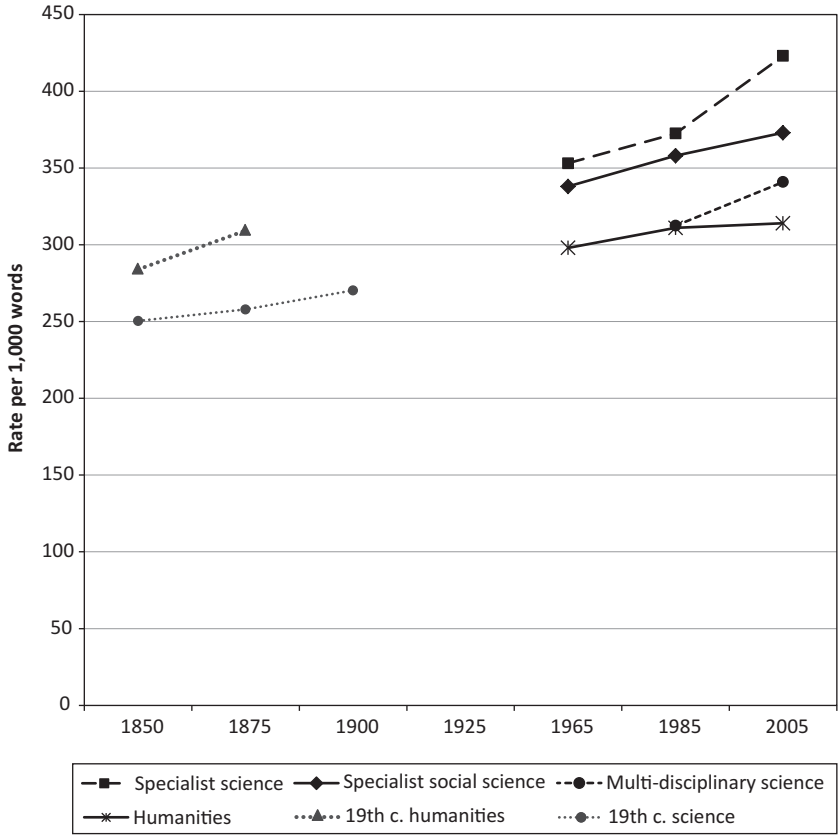


Figure 4.12 Historical change in the use of nouns across academic sub-registers

specialist science research articles, where nouns have increased by over 10% in just the last 20 years. Specialist social science articles follow the same increasing trend as specialist science articles, but to a less extreme extent. The trend towards increased use of nouns has also affected multi-disciplinary science articles, but it is considerably less marked than in either of the specialist sub-registers.

Appendix 2 presents the actual mean scores and standard deviations for nouns (and several other grammatical features) across academic sub-registers in recent historical periods. The first row in Table 4.4 presents the results of a factorial ANOVA to test the statistical significance of the mean differences for nouns across three recent historical periods (1965, 1985, 2005) and across the four academic sub-registers. Both main effects

Table 4.4 *Summary of the ANOVA factorial models for four academic sub-registers (specialist science, specialist social science, multi-disciplinary science, humanities) in three recent historical periods (1965, 1985, 2005)*

	Model F-Score	Model Significance	Model R^2	Year	Sub-Register	Year * Sub-Register
Nouns	51.0	<.0001	0.477	<.0001	<.0001	<.0001
Nominalizations	7.9	<.0001	0.124	<.0001	<.0001	ns
Relative Clauses	33.6	<.0001	0.376	ns	<.0001	ns
Noun + *of*-phrase	10.5	<.0001	0.158	<.0001	<.0001	ns
Noun + Noun	71.1	<.0001	0.560	<.0001	<.0001	<.001

(historical period and sub-register) show significant differences. In addition, there is a significant interaction effect here, reflecting the fact that humanities research writing has changed little in the use of nouns, while the frequency of nouns has increased dramatically in the science sub-registers (see Figure 4.12).

Nominalizations have followed a quite different developmental path from common nouns. Figure 4.13 shows that the frequency of nominalizations has increased in all sub-registers of academic writing. Surprisingly, though, the pattern of sub-register diversification is the opposite of that found for common nouns: nominalizations have increased the most in specialist social science articles and in multi-disciplinary science articles, and they have also increased considerably in humanities research writing. In contrast, the increase is considerably less pronounced in specialist science articles. (Table 4.4 shows that these mean differences are statistically significant for both historical period and sub-register.)

The discussion in preceding sections has documented a general decrease in the use of clausal modifiers, complementing the increase in nominal/phrasal features. For example, Figure 4.7 shows that relative clauses have decreased in both fiction and academic prose over the last century. Figure 4.14 provides additional information about this trend, showing that there have been distinct patterns of change among academic sub-registers: The decrease in use is by far strongest in specialist science articles, where relative clauses have declined by 50% from 1900 to 1965. Specialist social science articles also show a strong decline in use, while the multi-disciplinary science articles show a lesser decline in use. And in contrast to all science sub-registers, history

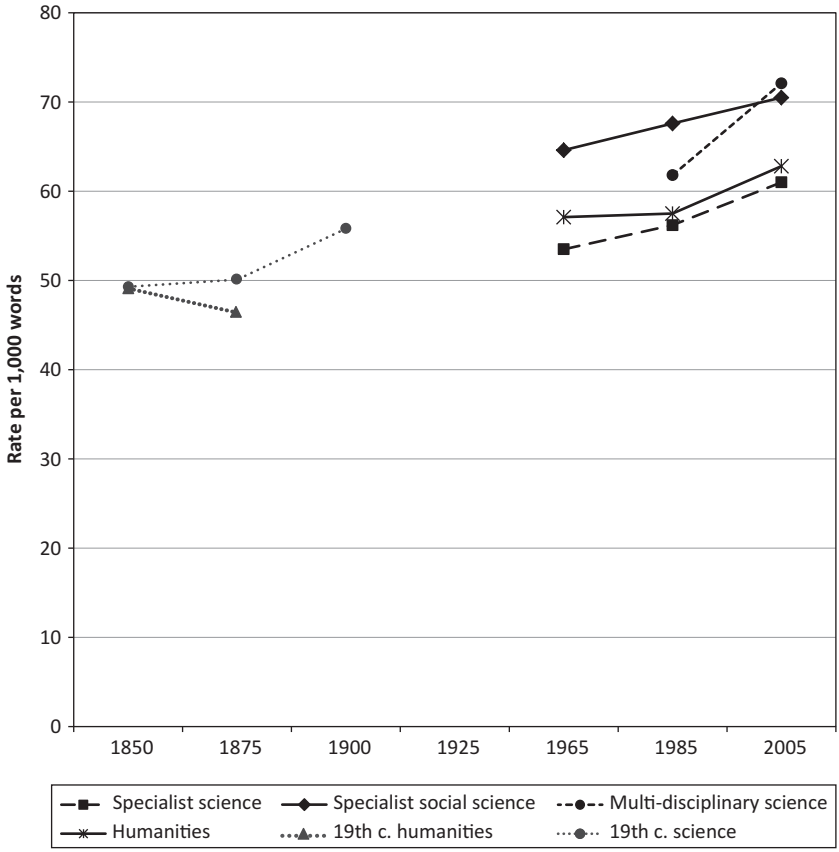


Figure 4.13 Historical change in the use of nominalizations across academic sub-registers

research writing has remained essentially unchanged over the past century in its heavy reliance on relative clauses for nominal elaboration. As a result, relative clauses are at present considerably more common in humanities academic prose than in any of the science registers.[2]

Figure 4.15 shows that post-nominal *of*-phrases have followed a similar historical path: strong declines in specialist science and social-science

[2] The ANOVA results reported in Table 4.4 are based on historical change for the three recent historical periods – 1965, 1985, and 2005. Thus, the results for relative clauses show a significant difference for sub-register, but no significant difference for historical period. That is, the large historical decrease in the use of relative clauses in science writing occurred in the early twentieth century, while these registers have remained relatively unchanged in their infrequent use of relative clauses over the past fifty years.

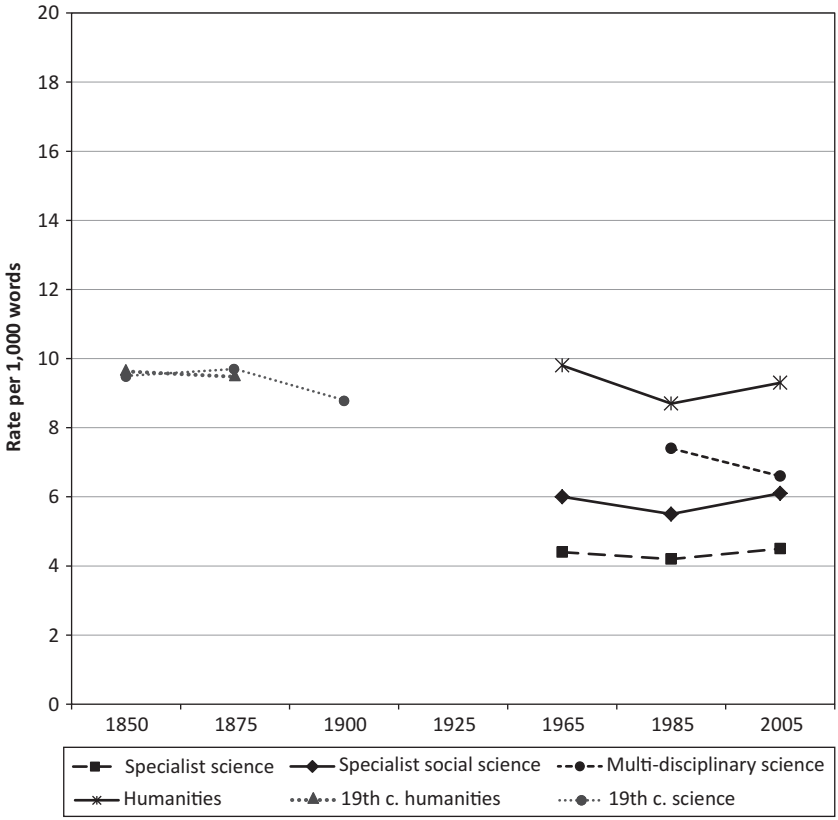


Figure 4.14 Historical change in the use of relative clauses across academic sub-registers

articles; a lesser decline in multi-disciplinary science articles; and essentially no change in history research writing. Those trends are in marked contrast to historical change in the use of post-nominal phrases headed by other prepositions (e.g., *in, on, for, with*), which have increased dramatically in science research writing over the last century (see Figure 4.9; cf. the discussion of Figure 3.12 in Chapter 3).

These findings (together with the findings in Section 3.3.4) show that there are important linguistic differences among academic sub-registers, and thus the cover term 'academic prose' is not so useful in referring to a grammatical discourse style. For example, the discourse of humanities research writing has changed little over the past three centuries: it still

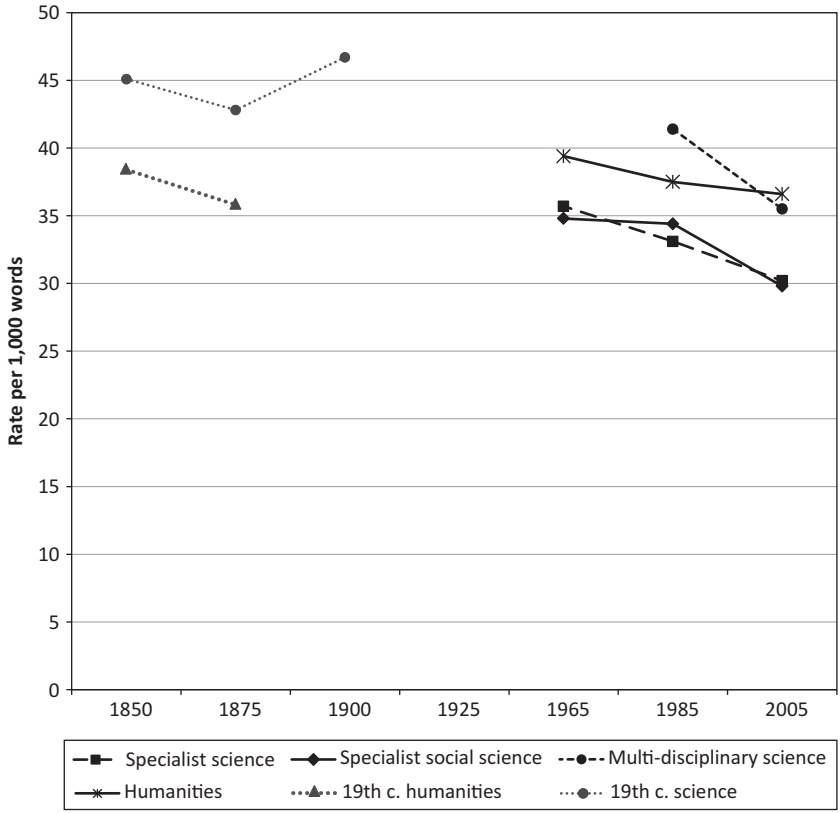


Figure 4.15 Historical change in the use of noun + *of*-phrase across academic sub-registers

employs frequent dependent clauses, and makes comparatively little use of phrasal noun modifiers. In contrast, the discourse of science research writing has undergone extensive change, shifting from a clausally-elaborated style to a style employing a dense use of noun phrase modification.

In addition, the most important linguistic changes have not been associated with the grammatical features usually targeted in previous research. Two of the most salient grammatical devices used for noun phrase modification (relative clauses and *of*-genitives) have actually declined in use in specialist science writing. Nominalizations have increased only slightly in specialist science research articles, while they have increased to a greater extent in social science and multi-disciplinary science articles.

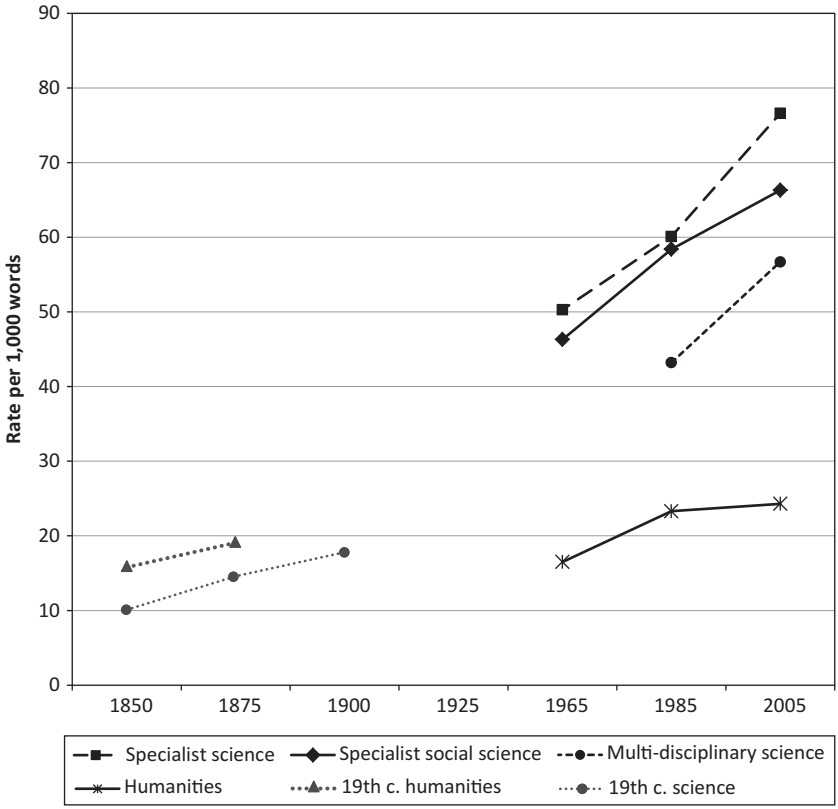


Figure 4.16 Historical change in the use of nouns as nominal pre-modifiers across academic sub-registers

So what has increased in use in specialist science research writing, resulting in the distinctive discourse style documented in Chapter 3? Probably the most important grammatical development has been the dramatic increase in the use of nouns used as a pre-modifier of a head noun (e.g., *patient history, case study*). As Figure 4.16 shows, pre-modifying nouns were only moderately common in the nineteenth century, but they have increased in use by as much as 400% in the twentieth century. This increase has been strongest in specialist science research writing, and also very strong in specialist social-science writing. Multi-disciplinary science writing is progressing in the same direction, but it lags behind the specialist sub-registers in the extent to which this device is employed. In contrast, history research writing has increased only slightly in the use of this

feature. These developments are significant across historical periods and across sub-registers (see Table 4.4). In addition, there is a significant interaction effect for this feature, reflecting the fact that humanities writing has changed little, in contrast to the dramatic increase over time observed for science writing.

4.5 Chapter summary

In summary, there are important differences across sub-registers of academic research writing in the extent to which they have permitted grammatical innovations associated with the increased use of phrasal devices modifying head nouns. In particular, we have shown that specialist science research articles have been the most 'agile' academic register (to employ the term used by Hundt and Mair 1999), exhibiting a remarkable change in discourse style over the course of the twentieth century. Thus, far from being 'up-tight' and resistant to change, we have shown how specialist science research articles have changed dramatically in their use of phrasal grammatical devices associated with informational 'compression'. It turns out that these are not merely changes in frequency of use: in Chapter 5, we discuss the functional extensions associated with these quantitative trends.