TOWARDS A SYSTEMIC FUNCTIONAL MODEL FOR COMPARING FORMS OF DISCOURSE IN ACADEMIC WRITING

Meriel Bloor
University of Warwick, United Kingdom

Abstract

This article reports on research into the variation of texts across disciplines and considers the implications of this work for the teaching of writing. The research was motivated by the need to improve students' academic writing skills in English and the limitations of some current pedagogic advice. The analysis compares Methods sections of research articles across four disciplines, including applied and hard sciences, on a cline, or gradient, termed slow to fast. The analysis considers the characteristics the texts share, but more importantly identifies the variation between sets of linguistic features. Working within a systemic functional framework, the texts are analysed for length, sentence length, lexical density, readability, grammatical metaphor, Thematic choice, as well as various rhetorical functions. Contextually relevant reasons for the differences are considered and the implications of the findings are related to models of text and discourse. Recommendations are made for developing domain models that relate clusters of features to positions on a cline.
Keywords: SFL; academic writing; domain-models

Introduction

This article addresses discoursal and linguistic variation across disciplines in academic writing and considers the implications of these differences for domain models of text in a systemic functional framework. In particular, this work investigates some of the differences between Methods sections of research articles in distinct disciplines. The primary motivation of the original textual investigations reported here was to assist the teaching of academic writing in English, but the work has wider implications for our understanding of how academic cultures influence language and discourse. This, in turn, supports arguments in favour of bringing students as quickly as possible into contact with international discourse communities relevant to their fields of study.

Models of language and the teaching of academic writing

Halliday and Matthiessen (1999, p. 545) make a distinction between *general potential models* and *domain models* of language, the latter referring to models of specific varieties or genres of a language, the former being a 'generalization across the full range of … field-specific varieties' (page 323). Both types of model are seen by Halliday as cultural constructs construed in language or other semiotic systems (such as diagrams or drawings). Since textual instances are rarely, if ever, repeated word for word, a model is inevitably a generalization across specific instances of text. Halliday cites the example of a cooking recipe, which is created afresh in each instantiation but which repeatedly confirms the established pattern of recipes. The distinction between general potential models and domain models is then one of degree, –or, one might say, position on a cline of specificity. At one end of the scale is a particular text (an *instant*) and at the other is the overall meaning potential of the whole language. In an intermediate area we find specific domains.[1]

Research into the language and discourse of specific domains has formed the basis of many courses in English for Specific Purposes (ESP) and English for Academic Purposes (EAP) in recent years, and models of genres habitually in use by discourse communities have proved especially influential.

Halliday's classic model of language as social semiotic (Halliday 1978, p. 69) was designed to demonstrate the social factors (including the context of situation of the linguistic event) that govern the production of text and to relate this to the development of a child's linguistic system. This is a complex *general potential model,* much of which is outside the scope of this article, but the relevant elements trace the relationships between the social system, the context of culture, the situation types, social contexts (field, tenor and mode) and draw the link between these and the ideational, interpersonal and textual metafunctions of the adult linguistic system. The theory represented in this model is evident in many of the more domain specific models developed in the last ten or twenty years in that they usually take into account such matters as who is communicating with whom, in what context and for what purpose.

Domain specific models have proved of direct interest to those working in language teaching or other educational projects. Particularly well-known are models of spoken discourse, such as the work of Sinclair and Coulthard (1975) on classroom interaction, conversational models (Eggins & Slade, 1997), and models of service encounters across cultures (Ventola, 1983). In relation to academic writing, the most influential work has probably been that of Swales (1990) on academic genres, in particular his model of article introductions (1990, chapter 7), and there have been a number of attempts at pedagogic domain models for commercial texts such as business letters.

The specific question that we raise here, however, is how far domain models (such as Swales' model of article introductions) can be utilized effectively for teaching and how far we need to take into account more delicate linguistic issues. For the purposes of our argument, we take the case of *Methods sections* in research articles and consider how they vary from discipline to discipline. This provides an illustration of

some of the complexities that arise in real texts, which, in turn, leads us to re-consider what must be captured in effective models.

The case of Methods sections in research articles

The research underlying this discussion came out of a practical teaching situation: instruction in academic writing for international graduate students in British Universities in courses in English for Academic Purposes. Such students need to read research reports and to prepare reports of their own research, sometimes for publications. Many graduate students hope that they will eventually be able to publish their work in learned journals. Students on such courses are often taught in interdisciplinary groups, usually because it is not economically viable to run separate courses for each department or faculty. Consequently, when lecturers consider students' needs they may centre their courses on what aspects of the language can be taught to all students regardless of discipline. As a direct result of this practical constraint, much previous research has naturally focused on identifying the features of academic writing that are held in common across disciplines. However, when students are required to read in their field or write up their work for publication, it is often the case that discipline-specific factors come into play. Novice writers find that what they have been taught in writing class and the examples they have been given differ considerably from the norms of their own subject field. Obviously, it is the case that lexis differs with field (although certain types of so-called *academic lexis* seem to be field-blind in English at least in certain contexts[2]), but in such texts there are not only lexical differences with their concomitant collocations. There are also rhetorical and grammatical differences.

Most models of the structure of research articles and reports propose that these consist of pre-determined sections such as, for example, *Introduction, Methods, Results, Discussion, and/or Conclusion* (see Swales, 1990 for more detailed discussion). Many scientific, technical and medical journals provide an outline of expected sections in their notes for authors, almost invariably demanding a so-

called *Methods* section. Journals in humanities and arts disciplines are usually more flexible and few require Methods sections. Social science journals differ considerably in their requirements, depending on whether they see themselves as aligned to a rigid 'scientific' or statistical approach to research, in which case they require the Methods section, or to a caring, more humanitarian branch of the discipline, where a description of Method section would be irrelevant since the article (or report) describes case studies or discusses good practice.

Any section heading may, of course, indicate different expectations in different disciplines. However, Methods sections may seem to be more predictably similar than some others, but like most instances of appear to be fairly straightforward and easy to write because they purport to give a simple account of the methods used by the researcher in such a way as to allow the research to be replicated by others. In systemic functional terms they would fall cognitively within the ideation base: concerned with construing our experience of the world. This would allow for a straightforward descriptive style stating what the researcher did, and maybe, in some cases, why he did it. Most standard books on writing instructions present Methods sections in this way language in use, our intuitive understanding of what is going on is often unreliable. Methods sections would (e.g. Day, 1989, pp. 35-39; and Weissberg & Buker, 1990, pp. 90-132), usually with such precepts as 'be precise', 'give full details', 'provide enough detail that a competent worker can repeat the experiments'. In fact, the analysis of actual Methods sections reveals that nowadays published writers rarely provide such detailed precision (possibly because of space restrictions in journals or editorial policy) and that, even in the hard sciences, it is normal for anyone wishing to replicate research to contact the original authors to acquire detailed access to methods. The Methods section in the hard sciences gives *an indication* of the type of methods but little more.

Swales and Feak (1994) in their textbook on academic writing for graduate students do not fall into the trap of the traditional handbooks, but neither do they have much advice to give the would be writer. They do, however, draw attention to the fact that there are differences in

Methods sections of research articles in different disciplines, proposing a cline from what they term *slow* to *fast* text. They note that in certain disciplines, such as *education, social science* and *public health*, Methods sections tend to be 'slow-paced', and that they are "explicit about details and procedures" with "justifications, explanations and, sometimes, examples" (p. 165). In sciences, engineering, and medical research, however, such details are often lacking. They suggest that the reason for this is that "standard practices and established methods are much more widely available and so explanations are not necessary as long as research follows the standard procedures" (p. 165). They propose a four point scale: *Slow - Fairly Slow - Fairly Fast - Fast,* with the science disciplines at the fast end and the humanities and social sciences at the slow end of the scale.

The current research investigated this hypothesis by a detailed analysis of typical texts from a range of journals. Was it true that social scientists spent more time than hard scientists justifying their methodological choices? And how far was it possible to identify measurable characteristics of such texts that correlate with the cline dimensions? That is to say, what does speed really mean when we are talking about language in use? And, perhaps even more importantly in terms of an overall model of text and social dimensions, is there a case for incorporating this cline or similar clines into model building at the domain level?

The texts and their analysis

The Methods sections came from issues of reputable journals from four separate disciplines. Incorporated in the collections of texts were two types of public health texts, from different journals, to check on how far house styles and slightly different approaches to a subject would effect the results. This was meant as an informal type of control analysis, but this complicating factor is not relevant to the present discussion since the results for the two public health texts were largely similar, –so here we consider the results from just the four types given in Table 1.

The journals were selected on the basis of the fields mentioned by Swales and Feak with advice from subject specialists. For convenience, the broad collection of stylistic differences in the texts is referred to in terms of speed: (slow - fairly slow - fairly fast - fast). A sample text from each journal, along with the name of each journal, can be found in the Appendix. The report presented here relies mainly on the analysis of these sample texts which were representative of the larger corpus.

Table 1

Text Type	Speed	Field
Type 1	Slow	Applied Cognitive Psychology
Type 2	Fairly slow	Public Health A
Type 3	Fairly fast	Medicine[3]
Type 4	Fast	Materials Science

These texts were analysed for a variety of features: length, sub-sections, number of paragraphs, sentence length, lexical density, readability levels, and use of grammatical metaphor and process types. In the next section, we consider the results, the similarities and differences across disciplines and discuss some possible reasons for these.

Results of the analysis

Before looking at the differences in the texts, it was observed that the texts had certain common features. None presented the overall aims and objectives of the research and, contrary to expectations, none provided sufficient information for the research to be completely replicable although the slower did give relatively more information. Subject specialists confirm that if one wishes to replicate a piece of research, it is often necessary to contact the original researchers for more details unless one is already familiar with the work of the authors.

Of course, in many close discourse communities, in the age of telecommunications and the internet, researchers in the same discipline are often already familiar with the types of work being undertaken by others. For further discussion of related issues see Swales (1990, p. 121) and Myers (1990, pp. 121-125).

Text 1 in our sample has most of the characteristics we would associate with so-called slow text in terms of content and linguistic features. Perhaps most significantly the text is long, with 669 words and with a relatively long sentence length of over thirty words per sentence. This length contrasts with average sentence length of 23.8 words per sentence in the Brown corpus of US scientific writing (Huddleston, 1971) and of 27.6 words per sentence in Barber's (1962) analysis of scientific texts. Text 2, although shorter than Text 1, is also much longer than the fast texts. Text 2 has 289 words and an above average sentence length of 28.9 words.

An earlier study, reported in Bloor (1999), analysed a larger corpus of Methods sections for linguistic features and identified further variable characteristics relating to sentence length, lexical density and readability. While there was no observable cline in the figures for readability (discussed further below), this analysis indicated a cline in measurable characteristics showing a tendency for slower texts to have longer sentence length and lower lexical density than faster texts. The results for the sample texts given in the appendix are shown in Table 2:

Table 2

Text	Length in Words	Number of Paragraphs	Words per Sentence	Lexical Density	US Grade Level
Text 1	665	8	30.4	51.7	11
Text 2	289	2	28.9	64.35	13.9
Text 3	90	1	29.7	66.44	14.6
Text 4	152	1	25	68.42	11.5

Although there is considerable difference between the length of slow and fast Methods sections, Medical Methods sections were often found to be shorter than those in Materials Science, as is indicated in the sample. Unsurprisingly, the longer (slower) texts tended to have more paragraphs, and sometimes even sub-sections, and shorter (faster) texts fewer paragraphs, usually only one.

Lexical density, however, was a more consistent variable. The lexical density of a text is a measure of the number of lexical items in proportion to structure words. It is recorded here by showing the percentage of total number of words that are lexical items. Thus a lexical density of 50 would mean that 50% of the words in a text were lexical items and 50% were structure words (that is to say words from the closed sets such as pro-forms, prepositions, verb auxiliaries, articles). As can be seen from the table, the faster texts have higher lexical density and this decreases according to the field.

Previous studies of lexical density in English have also indicated variation according to field, mode and tenor. Ure's seminal (1971) study comparing lexical density across the spoken-written divide identified a range of 35.8 to 56.8 with written texts having, on the whole, higher lexical density than spoken. At the lower end of the range, much spoken conversation had a lexical density of only 35.8 whereas written texts were in the upper section of the range. The highest lexical density she identified was scored by a report in *The Times* newspaper. From the Methods sections in the present study only the slowest text comes within the range of Ure's texts with a lexical density of 51.7. Even the *fairly slow* category has a high lexical density in Ure's terms and the fast texts are considerably higher. Stubbs (1996, p. 73), in his lexical density analysis of large corpora, identified a range of 40 to 65 as the range for written texts. The higher figures were found in non-fiction, including academic articles and bureaucratic documents. In Methods sections of research articles the fast texts exceed Stubb's highest figure. The reason for this lies in the condensed nature of the information and the use of grammatical metaphor.

Swales and Feak pointed out that in the Social and Applied Sciences methodology is often an important and 'hotly contested issue'. This may account for the length of Method sections in the journal *Applied Cognitive Psychology* and *Addiction,* from which our sample texts are taken. Both texts have sub-sections, 4 in the case of Text 1 and 2 in Text 2. The authors are explicit about procedures, describing the materials used and the instructions given to the research subjects (paragraphs 4 and 5) even though not all necessary information is given, and, especially in Text 1, they provide what may appear to be unnecessary details.

Why, we might wonder, does the reader need to know that the subjects *received a small contribution towards their course grade in return for their participation*? The reason for some of the detail may lie in the possibly dubious nature of the research, where the subjects were deliberately told lies about the true purpose of the tasks they were undertaking. The authors clearly feel the need to provide a lengthy explanation of the deception (1st and 2nd paragraphs), and even repeat the point in the third paragraph (*As noted above, they were naïve to the true nature of the research and, in fact, were misled as to it.*), and refer to it in the seventh when they explain that they try to make the test convincingly difficult *as part of the guise.*

The authors of Text 1 also give examples of the data used and offer explanations for the complexity of the procedures (*the purpose here was to make the test convincingly difficult*). There is no use of specialist terminology that would be inaccessible to a lay person and there is no need for explanations of terms.

Text 2 includes a great deal of detail, such as information about where the subjects were selected (*at methadone posts, at a weekly held STD clinic for drug-using prostitutes,* etc*),* details of research personnel (*especially trained nurses)* and specific dates (e.g. *In 1990 and 1993)* and places (e.g. *on the street in Amsterdam)* and time periods relevant to the research stages (*every four months, a 6-month period,* etc.*).* Unlike Text 1, it does not include explanations or reasons for the procedures; it

simply states them as having taken place and in this respect is more similar to the so-called fast texts. Another similarity is the inclusion of a certain number of technical terms, which are not evident in Text 1 but are prolific in the faster texts. The authors of Text 2 assume some knowledge on behalf of the reader with respect to established research techniques and do not explain the technical terms that they use:

> Blood is drawn at each visit and tested for HIV by *enzyme-linked immunosorbent assay (ELISA);* positive specimens are confirmed by *immunoblotting*. (my italics)

However, unlike the fast texts, they do provide endnote references for the various techniques mentioned, those above and the later tests *finger-stick method* and *HIV antibody testing*. Text 2 also assumes some familiarity with standardised questionnaires, which are referred to twice without references.

The fast texts take such assumptions about the readers' prior knowledge to extremes. Generally, there is no repetition, no justifications or explanations are given, and no terms are explained. No references are provided for standard tests or procedures, but the reader is expected to be familiar with such procedures as *emergency endoscopy, sclerotherapy, rescue therapy* (Text 3) and *x-ray diffraction analysis; compositional analysis; dielectric and AC-conductivity measurement* (Text 4). Similarly, there is an assumed mutual knowledge of medical drugs, in the case of medical texts, and technical equipment and technical measurements in both.

The question of how far a reader of a text is familiar with the terminology and concepts of a discipline is related to the issue of readability. Clearly, a text like Text 4 will not mean much to a reader who shares no mutual knowledge with the authors on the subject of crystal growth and its measurement. Yet, as can be seen from Table 2, the readability index used for the present sample of texts, gives the US Grade Level of Text 4 as only little higher than that of Text 1, indicating

that the text is of a suitable reading level for students in Grade 11 in the USA (that is in upper secondary school). Common experience tells us that most high school students, or even most undergraduate students, will not, in fact, be able to read this text with understanding. The reason for the anomaly is that standard indices of readability rely on the measurement of what can easily be measured, that is to say, factors such as sentence length and length of words (as measured by number of letters or syllables). The figures for readability in Table 2 were arrived at by computational analysis (Flesch-Kincaid readability index), and the outcome does not reflect the text's obscurity to the non-specialist. The sentences are not long, as we have seen, and the presence of short formulae such as 'PbO', 'Cu', acronyms, such as 'LRC', and numbers (such as '100') distorts the results since these are counted as short one-syllable words. Text 3, on the other hand, with fewer formulae and numbers, scores much higher on the readability index.

Another, fairly obvious difference between the slow and fast texts is the frequency of references to the researcher/s and, where appropriate, the subjects of the study. Although there is a high frequency of passive voice verbs in all Methods sections, averaging 25%, we do not often find *Actor* or *Senser* in Subject or Object position in the fast texts. Clauses in Group A below can be contrasted with those in Group B. The italicised words are those referring to subjects used in the research or research workers and their representatives.

Group A
subjects were shown a series of phrases (Text 1)
they were told to say nothing (Text 1)
50 volunteer undergraduates participated in the first study (Text 1)
HIV-positive drug users were required to be free of AIDS (Text 2)
Participants are asked to return every three months (Text 2)
IDUs were recruited at key points (Text 2)
(IDU = intravenous drug user)

Group B the memory stimuli consisted of 16 phrases (Text 1)
both surveys formed part of a European multicentre study (Text 2)
intravenous bolus doses of somatostatin … were injected (Text 3)
active bleeding was observed (Text 3)
compositional analysis was performed (Text 4)
plates 10 x 10 x 1mm^3 were sliced parallel to the face (Text 4)

While all Methods sections investigated contained clauses of the type in Group B, the occurrence of type Group A was relatively rare in medicine and almost non-existent in the hard sciences. In the sample texts, there is only one example in the medical Methods section:

> In this double-blind prospective trial, *patients* who had cirrhosis with upper gastrointestinal bleeding were randomly assigned natural somatostatin (6mg per 24 h) or a placebo for 120 hours.

There is no other mention of the subjects although many processes acting directly on the patients are referred to, –including death. Similarly, in Text 4, the experiment happens, but there is no reference to the involvement of the researchers, even though the many processes they undertook are summarised (*grinding, polishing, etching,* etc.) thereby implying their presence.

Thus, in summary, we can see that

Slow texts

- are explicit about procedures, incorporating details
- provide exemplification
- offer reasons or justification for certain procedures

Fast texts

- assume an expert readership
- assume that readers are familiar with research methods
- do not provide examples
- do not attempt to justify procedures

In Table 3, differences are represented in the content of the Methods sections across the four disciplines, based on sample texts. (Three plus signs (+) indicate frequent instances, two indicate the presence of some instances and one indicates the occasional single instance.)

Table 3

Text	Examples	Justification	Details	References to Researchers/subjects
Text 1	+ + +	+ + +	+ + +	+++(15)
Text 2	+		+ + +	++(10)
Text 3				+(1)
Text 4			+	+0

Grammatical metaphor in fast texts

Halliday (1994, p. 249) proposed the term *grammatical metaphor* for expressions where meaning is represented metaphorically, not merely in the choice of lexis but also in the grammatical construction. The assumption is that *processes* (material, mental, relational and so on) are typically represented as verbal groups, and that their *participants* and *circumstances* are represented as nominal groups, adverbial groups, or prepositional groups, taking their places as Subject, Object or Adjunct of the clause. Alternative grammatical realisations, such as the case where a process is represented as *thing*, say as head of nominal group, would be termed metaphorical. Halliday gives, as an example of a congruent form, the following:

> *Mary* (senser) *saw* (mental process) *something wonderful* (phenonemon)
>
> Metaphorical realisations of this could be
>
> *Mary* (Actor) *came upon* (Material process) *a wonderful sight* (Goal).
>
> or
>
> *A wonderful sight* (Actor) *met* (Material process) *Mary's eyes* (Goal).

In the metaphorical versions, the sensory mental process is in a sense 'hidden' by being represented by the head of a nominal group (*sight)* rather than by the verb *saw.* This in turn is modified by the epithet *wonderful,* which in the non-metaphorical form was part of the object of the clause.

In our data, the following nominal groups could be said to represent processes in a similar way.

From Text 3

upper-gastrointestinal bleeding

when *active bleeding* was observed

treatment failure

the occurrence during the transfusion period

excess transfusion of blood products

rescue therapy

death

From Text 4

the *growth* [of the crystals]

X-ray diffraction *analysis*

compositional *analysis*

an Everhest Thorney *detector*

the dielectric and AC-conductivity *measurements*

the dielectric and electric *measurements*

a plane *capacitor*

Without going into the debatable question of whether these complex nominal groups are all actually grammatical metaphors, it is clear that if the processes realised here were not expressed nominally, the texts overall would be longer and lexical density would be lower. Contrast, for example the pairs given below, where the first in each pair is the authentic example (from the fast Methods sections) and the second is a constructed equivalent version:

> 1a. patients who had cirrhosis with upper-gastrointestinal bleeding were randomly assigned natural somatostatin … or placebo …
>
> 1b. patients who had cirrhosis and who were bleeding from the upper-gastrointestinal tract were randomly assigned natural somatostatin … or … placebo …
>
> 2a. when active bleeding was observed
>
> 2b. when the doctors observed that the patient was bleeding actively
>
> 3a. treatment failure

3b. when the patient failed to respond to treatment

4a. defined as the occurrence during the transfusion period of at least one of ...

4b. defined as, when, during the period when blood was being transfused, at least once of the following occurred:

5a. death

5b. the patient died

Far fewer processes appear in nominal groups in the slower texts where Subject position in the clause is more often filled by more straightforward nominal groups. Furthermore, as mentioned above, these often refer to humans (or in some disciplines animals). In Text 1, for example, there are no less than nine Subjects realised by a word referring to the students who acted as research subjects, either as 'subject', 'subjects', or 'they' (in one case). Although some nominal groups in this text are fairly long, they are not normally grammatical metaphors, but are of the type 'a key component of the test'. A few grammatical metaphors appear as in 'a total of 50 volunteer undergraduates', where arguably 'volunteer' stands for 'who volunteered', but these are of a very different type from those in the hard science texts. In Text 2 they are slightly more frequent, as we would expect, and are found in the nominal groups referring to standard procedures: *chain referral sampling* and *HIV antibody testing*. This practice of encoding processes, particularly material and mental processes, as -ing forms acting as heads of nominal groups, or what are traditionally known as *gerunds*, is much more likely to be found in non-expert discourse. *Singing, swimming, thinking,* and many more are usual in everyday spoken discourse as Subject and Object or Complement of the clause.

One general advantage of encoding processes as nouns is that the process is made available for Theme[4] position in the clause[5]. This assists

in establishing a cohesive text without the necessity of repeating an Agent (whether it is the researcher or the subjects). The process can then also be modified by an epithet or a classifier. Thus, we find the underlined Themes in a section of Text 4:

> X-ray diffraction analysis was performed with a DRON-3M powder diffractometer using Cu Ka (l = 1.54187A). The compositional analysis was performed using a Philips 515 scanning electron microscope equipped with a Everhest Thorney detector and WEDAX-3A. The dielectric and AC-conductivity measurements were conducted using two LRC meters (Hewlett-Packard models 4275 and 4250) operating in $l0^2$-$l0^5$ Hz und $l0^4$-10^7 Hz ranges, respectively.

Each Theme in this section represents a process in the method of the experiment. The first two refer to types of analysis which are contrasted by pre-nominal classifiers: *X-ray diffraction* analysis and *compositional* analysis. Similarly, two kinds of measurement were undertaken and these are differentiated by the conjoined classifiers *dielectric* and *AC-conductivity.*

Thematic choice is a strong differentiating agent between fast and slow text, although intermediate text types (fairly fast or fairly slow) are more fuzzy in this respect. In very fast texts all Themes are ideational and almost all take Subject position in the clause. In slow texts, on the other hand, multiple Themes, and Ideational Themes (known also as Topical Themes) may be preceded by interpersonal or textual Themes. This can be seen in sample Text 1, where there are both Textual Themes (*In addition; For example; Finally),* and Interpersonal Themes in the form of comment adjuncts: *In actuality, of course.*

In addition, in slower texts, we find more Adjuncts as Theme in initial position in the clause. This is evident in sample Text 2, where 38% of sentence Themes are Circumstantial Adjuncts: *In December 1985; At intake; At first visits; At repeat visits; In 1990 and 1983.*

Related theoretical issues

The question of nominalizations in these texts relates to an issue about language that is considered in some detail in Halliday and Martin (1993). In particular, Halliday's (1987) paper 'Language and the order of nature' discusses what he refers to as the 'attic' and 'doric' modes of discourse. The terms *fast* and *slow* do not precisely equate with attic and doric, but they do seem to have much in common with them, attic sharing some characteristics of 'fast' and doric some characteristics of 'slow'. Halliday associates the attic with the written form of English and the doric with speech; the former is seen as more fixed and rigid (synoptic) and the latter as more fluid and dialogic (dynamic). Halliday discusses attic and doric in terms of grammatical features paying no attention to rhetorical features (exemplification, detail, and so on). He also considers the historical evolution of the language, proposing that the attic mode in scientific discourse opened the way to a new theory of reality, one where even a whole clause can be expressed as a nominalization, as in: "I'd visited before and I'd always ended up feeling uncomfortable" with "every previous visit had left me with a feeling of discomfort". Halliday points out that this kind of metaphorical discourse (discussed in more detail in Halliday and Matthiessen 1999, Chapter 6) tends to mark off the expert from those who are uninitiated: "That kind of grammar cuts the layman out" (Halliday & Martin, 1993, p. 119).

Halliday suggests that the synoptic quality of scientific writing causes problems of ambiguity and inaccessibility for some readers. But does this mean, as some writers have suggested, that it is the job of the writing teacher to encourage moves towards the doric style? Although the general public might find it hard to understand specialist texts, recent work by Lassen (2003) indicates that many readers – especially expert readers–find the conventional technical writing style, along with its high frequency of grammatical metaphors, more accessible and acceptable than simplified versions. In fact, the attic

style seems to be an inevitable linguistic development in specialist discourse. Computer Science is a field where specialists made a serious attempt, in the early years to use informal and less 'expert' language, but where the inevitable happened and the informal terminology and phraseology itself became inaccessible to anyone without specialist knowledge (see Bloor, 1998). There are also practical issues that have to be considered, such as the problem of length. The attic style manages to squeeze a great deal of information into a small space by avoiding repetition and by exploiting high lexical density, as can be seen in the fast text samples. This may be considered an advantage, not only by publishers but also by busy readers who prefer information to be condensed and quickly accessible.

Of course, it is useful to raise graduate students' awareness of the options available to writers, but the social demands on academics to conform to the requirements of their particular discourse community are strong, particularly when publication may be at stake.

Towards a domain model of discourse

Finally, this work raises the question of whether, if one is analysing texts for pedagogic purposes, such as those discussed here, one needs to consider some type of stylistic cline to incorporate within the model. De Beaugrande (1985) suggested interestingly that a set of such clines may be an important component of textual variety. His list of possible clines included:

precise-fuzzy

certain-uncertain

general-specific

explicit-implicit

elaborate-plain

changing-repetitive

new-expected

innovative-commonplace

The *fast-slow* gradient is a cline of this type. Although more analysis would be required to establish norms across genres and disciplines, even impressionistic assessments of such questions as "How innovative is this text?" "Is the style elaborate or plain?" can be quite useful in the description of texts.

Clines of this type would not run contrary to Halliday's general potential model (1978) referred to above nor would it be contrary to his general theory of language. The position of any text or communicative event on a particular cline would be the product of the broader cultural context and the specific context of situation in which the text was constructed. Thus it would be dependent on the social relationship of the speaker-hearer or writer-reader, the time, place, conditions, field of discourse, and so on. In the case of a domain specific model, the broader cultural context would establish the conventions of the genre, established over time by the discourse community. These would include rhetorical conventions, such as the required sections and moves for a research article, but the complex interaction of other more immediate social factors and the practical constraints on form would govern the final text.

There is also the issue discussed by Hasan (1996) concerning writer and speaker *purpose.* As Hasan explains, discourse events are often goal directed. Part of the social aspect of any model is the purpose of the discourse and part of the 'social' is the purposeful. Hasan is right when she says that in monologic mode, 'the maker of the text must proceed from some notion of his (*sic*) frame of reference ... must have some notion of what he is attempting to achieve, who his audience is

and what strategy he is about to employ to achieve his end'. (Hasan 1996, p. 46 in Cloran et al). The question of the purpose of a text is one which was also addressed by Swales (1990), who claimed that "the principal criterial feature that turns a collection of communicative events into a genre is some shared set of communicative purposes." In the sense that a Methods section fulfils the academic community's understood purpose of making public the procedures used in a piece of research, Methods sections constitute a genre or, arguably, a *part* or *section* of the genre of research article. However, as is discussed above, there seem to be certain recognisable differences in purpose across disciplines. Social studies and psychology researchers' goals include providing a justification for some of their procedures. They also feel the need to provide quite a lot of detail about the conduct of the research. It may be that they also aim to communicate with a wider, less specialised readership, especially in applied fields. Hard scientists, on the other hand, as the specialist informants suggested, may feel that their purpose is merely to provide sufficient indication of what happened for expert readers to recognise the zone in which the research method falls. Close members of the specialist community will contact the authors if more information is required. Since purpose seems to be an important dimension in explaining the features in the texts, it is important to incorporate this into domain models as it could account for differences across disciplines. However, this would only work satisfactorily if it were possible to differentiate the subtle differences of purpose that can occupy the space known in more general terms as 'methods'.

Essentially, since it does not seem to be possible to identify a typical Methods section that would satisfy all disciplines, there can be no valid prototype for the genre. All but the most naïve readers of a language can recognise and informally comment on stylistic varieties in different texts. It is not difficult, for example, to perceive intuitively that there is a distinction between the styles of the Methods sections in certain disciplines, but our current text analysis demonstrates that it is possible to measure features of texts and to show a tendency for some features

to appear more frequently in some disciplines than in others. A cluster, or *set,* of these features could make up the components of a specific style that might be labelled as *fast* or *slow* –or as something in between.

No single measurable characteristic, however frequently it appeared in a text, could mark that text as fast or slow or position it at a particular point on a speed cline; it is only when a cluster of characteristics appears concurrently, that the text takes on the strong character of the variety in question. It is also important to note that normally no single characteristic can be said to be unique to a particular point on the cline in question. Hence, for instance, we cannot say that all fast texts must have a high frequency of short sentences. There may be, somewhere, a fast text with a lot of long sentences but with a high frequency of all the other characteristics of the set. It is simply that overall the totality of measurements will push the text into one or another category.

The collection of characteristics that we match to the cline forms a part of what Lakoff (1987, pp. 74-76) called a *cluster model.* The cluster model is based on the idea that we organise our knowledge in cognitive models that are socially agreed or accepted, and that these become established prototypes for the meaning of words. Lakoff writes, "It commonly happens that a number of cognitive models combine to form a complex cluster that is psychologically more basic than the models taken individually." Since a satisfactory individual prototypical model for all Methods sections cannot exist, we need a model that depends on the identification of sets of linguistic and rhetorical characteristics that together represent the style of a Methods section for a specific group of disciplines. It seems likely that discourse models generally may need to incorporate some kinds of stylistic clines indicating which sets of features predominate in distinct domains.

Texts, we might say, may bear *family resemblances* (to use Wittgenstein's term). They are "tied together by a network of resemblances, like the persons whose faces share features characteristic of a family." (Wittgenstein, 1953, pp. 66-71, summarised by Blackburn, 1994, p. 136). When we can identify these features, or shared

characteristics, we can measure them and grade or order them, remembering that members of a category may be related to one another without all members having any properties in common that define that category (Lakoff, 1987, pp. 12-17 and elsewhere).

Future developments

From this small investigation of a limited area of the genre of research articles, it appears that there is a strong case for using cluster models and clines in studying text variation. Future investigations could include the analysis of larger corpora to establish the most important feature clusters. This could help us to refine our domain models and to understand how and why text variability occurs as well as providing the basis for a number of applications, not least of which is to support the teaching of academic writing.

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Notes

1 It is important to appreciate that the word 'model' is used with a number of distinct meanings in linguistics. The term is used here for a model constructed by a linguist, discourse analyst, sociologist or teacher after some type of objective analysis of language in use. The best formal models of discourse capture people's intuitive conceptualization of the interaction, genre, or text type and, through their objectivity and detail, make us aware of how the linguistic event is conventionally structured or realised.

2 See, for example, Nation's (1990) work on academic word lists and Francis's (1986; 1994) studies of anaphoric nouns.

3 In certain branches of medicine, we are able to find longer and more discursive accounts of methods, especially in articles concerning medical social practice.

4 Note that *Theme* (with upper case 'T') and *process* and *participant* are technical terms in systemic functional linguistics and they are used with their technical meanings here. See Halliday (1994) or Bloor and Bloor (1995) for explanations.

5 Another advantage of nominal processes is that logical relationships between two processes (such as the cause effect relationship) can be encoded concisely (discussed in Halliday, 1987 and Bloor and Bloor, 1995, Chapter 11), but examples of this type are not evident in our sample texts.

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APPENDIX: METHODS SECTIONS OF RESEARCH ARTICLES

Text 1 (Slow text)

Methods

In the first of the present studies subjects were shown a series of phrases, one at a time, each being followed by a pause and, then by a signal to say those words aloud or, equally often, not to say them. The important point is that this delay presumably created a tentative intent, at the time, to say each of the phrases, including those that were not subsequently spoken.

All of this was explained to the subjects as an investigation into whether saying words outloud produces better memory for those words. In addition the procedure of not giving the outloud-or-not signal ahead of time was explained by also telling the subjects that this was done to ensure that 'you pay equal attention' to all of the phrases. In actuality, of course, real interest lay only in the phrases that had not been said aloud and even then, not in memory for their content, but for the fact that they had never been spoken, and the pause was inserted to produce an interval during which there was a preparation to speak.

Subjects

A total of 50 volunteer undergraduates participated individually in the first study. In this and the following studies (unless otherwise noted) subjects were recruited from introductory psychology classes and received a small contribution towards their course grade in return for their participation. There were no restrictions as to age or sex. As noted above, they were naive as to the true purpose of this research and, in fact, were misled as to it.

Materials

The memory stimuli consisted of 16 phrases (of 6 words each) based upon a newspaper article suitably modified such that the phrases, taken together, still formed a coherent whole. For example, the first three phrases were: 'Germany, watching the postwar era fade', 'Is struggling to redefine its role', 'Reunification started this process months ago'.

Procedure

Each phrase was shown to each subject on a printed card for a period of 5 seconds, followed by a blank card for 2 seconds. This blank was then followed (for a random half of the phrases) by a card with 'Say Outloud' on it or by a card containing the next phrase in the series. Subjects had been instructed to read each card silently, to be prepared to say it, but not to actually speak its words, until, and unless, told to do so. In the event that a new phrase appeared after the blank, they were told to say nothing, but to simply read the new phrase to themselves.

Immediately following completions of this series of 16 experimental phrases a 'filler task' was introduced consisting of the subject reading aloud the remainder of the original newspaper article. This required approximately 1 minute.

Finally, each subject was given a printed recognition test consisting of the original phrases in their original order, each being paired with a new six-word phrase of similar content. For example:

'Germany, watching the postwar era fade'.
'As Germany watches, an era fades'

'Is struggling to redefine its role'
'and it must change its role'.

The purpose here was to make the test convincingly difficult (as part of the guise) by making it more difficult to correctly recognize one phrase on the basis of correctly identifying the one that came before it

or solely on the basis of its own gist. The correct phrase was equally often first and second among the pairs that contained phrases that had been said aloud and among those that contained phrases that had not. Subjects were required to pick one and only one of each pair and to go through the pairs in the printed order.

The key component of the test was, however, this: informally, at the very end of the instructions for the test portion of the experiment (apparently as only an after-thought) subjects were told that once they had chosen and marked one sentence in a pair they were to 'make an "O" if you remember saying those particular words outloud'.

Parks, Theodore E. 1997. False memories of having said the unsaid: some new demonstrations. *Applied Cognitive Psychology*. 11:485-494.

Text 2

Methods

The cohort study

In December 1985, a prospective epidemiological study with a continuous intake of injecting and non-injecting drug users was started in Amsterdam.[3,10] At intake, HIV-positive drug users were required to be free of AIDS. Participants for this ongoing open cohort study were mainly recruited at methadone posts and a weekly held STD-clinic for drug-using prostitutes.[12] Participation is voluntary

and with informed consent. Participants are asked to return every 4 months for repeat visits. At all visits, specially trained nurses administer a standardized questionnaire considering non-parenteral and injecting drug use and sexual behaviour. Blood is drawn at each visit and tested for HIV by enzyme-linked immunosorbent assay (ELISA); positive specimens are confirmed by immunoblotting.[10] At first visits, questions about current behaviour refer to a 6-month period before intake, while at repeat visits current behaviour refers to the period between the present and the preceding visit.

Street surveys

In 1990 and 1993, cross-sectional anonymous HIV seroprevalence surveys were conducted 'on the street' in Amsterdam. IDUs were recruited at key points in town but distant from drug treatment centres, or by means of chain referral sampling.[13] Both surveys formed part of a European multicentre study.[11] Eligible participants were current IDUs who had injected at least once in the preceding 2 months. IDUs were interviewed using a standard questionnaire on socio-demographic characteristics, drug use, current injecting behaviour in the previous 6 months and knowledge of HIV serostatus. Fifteen per cent of IDUs in the 1993 survey also appeared to participate in the cohort study; this proportion was not known for the 1990 survey. Blood samples for HIV antibody testing in 1990 were collected on filter paper by the finger-stick method,[14] while in 1993 HIV antibody testing was performed on saliva samples.[15]

Fennema, J.S., E.Van Ameijden, A.Vande Hoek, & R.A. Couthinho. 1997. Young and recent-onset injecting drug users are at higher risk for HIV. *Addiction*. 92:11. 1457-1465.

Text 3

Methods

In this double-blind, prospective trial, patients who had cirrhosis with upper-gastrointestinal bleeding were randomly assigned natural somatostatin (6 mg per 24 h) or placebo for 120 h. In addition, intravenous bolus doses of somatostatin (250 mg) or placebo were injected after the start of the infusion, before emergency endoscopy or sclerotherapy, and when active bleeding was observed. The primary endpoint was treatment failure, defined as the occurrence during the infusion period of at least one of: excess transfusion of blood products, haematemesis, haemodynamic instability, need for rescue therapy, or death.

Avgerinos,A., F.Nevens, S.Raptis, & J.Fevery. 1997. Early administration of somatostatin and efficacy of sclerotherapy in acute oesophageal variceal bleeds. *The Lancet*. 350: 1495-99.

Text 4 (Fast text)

Experiental Methods

The starting materials for the growth of the crystals were PbO, PbF_2, und B_2O_3 (Merck, suprapur grade) und Sc_2O_3 und Ta_2O_5 (crystal grade). The process of growth took place in closed crucibles made of pure platinum with a diameter of 80 mm and height of 100 mm. X-ray diffraction analysis was performed with a DRON-3M powder diffractometer using Cu Ka (l = 1.54187A). The compositional analysis was performed using a Philips 515 scanning electron microscope equipped with a Everhest Thorney detector and WEDAX-3A. The dielectric and AC-conductivity measurements were conducted using two LRC meters (Hewlett-Packard models 4275 and 4250) operating in $l0^2$-$l0^5$ Hz und $l0^4$-10^7 Hz ranges, respectively. To carry out the dielectric and electric measurements, plates 10 x 10 x 1 mm^3 were sliced parallel to the face (100). After grinding, polishing, and chemical etching the plates, platinum contacts were coated by cathode sputtering and a plane capacitor was formed.

Petrova, D., S.Dobreva, M.Veleva, J.Macieck & M.Gospodinov. 1997. Growth, structure, dielectric behaviour and AC-conductivity pf pyrochlore lead-scandium tantalate single crystals. *Materials Research Bulletin*. 32.11:1543-1549.