ELSEVIER

Cognitive genre structures in Methods sections of research articles: A corpus study

Ian Bruce*

Department of General and Applied Linguistics, The University of Waikato, Private Bag 3105, Hamilton, New Zealand

Abstract

This paper reports a corpus investigation of the Methods sections of research-reporting articles in academic journals. In published pedagogic materials, Swales and Feak [Swales, J. M., & Feak, C. (1994). Academic writing for graduate students. Ann Arbor: University of Michigan Press; Swales, J. M., & Feak, C. (2000). English in today's research world. Ann Arbor: University of Michigan Press.], while not offering a generic structure, discuss the tendencies for Methods sections reporting research in the social sciences to be *slow* (or *extended*), and those in the physical sciences, such as medicine and engineering, to be *fast* (or *compressed*) − the metaphors of speed or density relating to the degree of elaboration employed in describing and justifying the research design and process. The aim of this study is to examine the differences between fast and slow tendencies in Methods sections in terms of their internal, cognitive discourse organization. Two small corpora, each consisting of thirty Methods sections (one for each of the two groups of subjects), are analyzed in two ways. First the corpora are rater-analyzed for their use of the organizational features of a *cognitive genre* model for textual structures (see Bruce, I. J. (2005). Syllabus design for general EAP courses: a cognitive approach. Journal of English for Academic Purposes, 4(3), 239−256.) and secondly by the use of corpus software for linguistic features that characterize the model. The findings of the study suggest that 'fast' Methods sections that report research in the physical sciences generally employ a *means-focused* discourse structure, and 'slow' Methods sections in social science reports tend to employ a combination of *chronological* and *non-sequential* descriptive structures. The study concludes that learner writers may benefit from access to the types of general, *procedural* knowledge that these discoursal structures employ. © 2008 Elsevier Ltd. All rights reserved.

Keywords: Methods sections; Genre; Text type; Procedural knowledge; Cognitive genre; English for academic purposes

1. Introduction

First this article presents the social genre/cognitive genre approach to discourse classification of Bruce (2005). This is followed by a review of existing analyses of Methods sections of research articles, the review leading to a proposal that Methods sections may be examined in terms of their use of general rhetorical structures, operationalized here by cognitive genres. The survey analyses of two corpora of Methods sections (fast and slow) are then presented. Finally the findings of the study are then discussed in relation to the types of knowledge that it yields for teaching the writing of Methods sections and also in relation to the need for a dual approach to analyzing genres in academic discourse.

* Tel.: +64 7 838 4466x6375; fax: +64 7 838 4788.
  E-mail address: ibruce@waikato.ac.nz

1.1. Social genres and cognitive genres

There is currently a multiplicity of approaches to the classification of discourse, which means that terminology, including the words genre and text-type themselves, is used in very different ways by different theorists and researchers. This is not simply a terminological problem, but rather arises out of disagreement about the very nature of the object of enquiry. For some, genre is largely a social phenomenon, seen as reflected in the conventionally recognized functions and conscious organizational structures of whole texts; for others, genre is a communicatively motivated, cognitive phenomenon — a phenomenon that is reflected only indirectly, if at all, in the social function and overall structure of texts. As a basis for analyzing Methods sections corpora, the study draws on a proposal for two types or levels of genre — *social genre* and *cognitive genre* (see Bruce, 2005).

Social genre refers to socially recognized constructs according to which *whole* texts (or conventionally recognized sections of texts, such as Methods sections in research articles) are classified in terms of their overall social purpose and function. Thus, for example, personal letters, editorials, novels and academic articles are examples of different social genres, which are created to fulfill different types of socially recognized and understood purpose. Purpose here is taken to mean the intention to consciously communicate a body of knowledge related to a certain context to a certain target audience. In fulfilling this type of purpose, social genres may draw upon knowledge relating to context, discipline-specific content, epistemology, writer stance and the related textual conventions employed in the selection and functionally-related staging of content — variously termed *generic structure* (Hasan, 1989) or *moves and steps* (Swales, 1990), all of which to some extent influence linguistic choices.

The term cognitive genre is used here to refer to the overall cognitive orientation and internal organization of a segment of writing that realizes a single, more general rhetorical purpose to represent one type of information within discourse. Examples of types of general rhetorical purpose relating to cognitive genres are: to recount sequenced events, to explain a process, to argue a point of view, each of which will employ a different cognitive genre. The rhetorical purpose will influence the local discoursal organization of the text, relations between propositions and linguistic choices related to cohesion and coherence. A particular example of a social genre (e.g., a personal letter) may draw upon a range of different cognitive genres in relation to the rhetorical purposes that characterize the different sections of the overall message as it unfolds (e.g., presenting an argument; providing an explanation, recounting a series of events).

1.2. Review of genre analyses of Methods sections

Existing research that has examined research-reporting texts has largely been carried out within the *English for Specific Purposes* (hereafter ESP) approach to textual analysis. One approach by ESP researchers has been to characterize certain categories of texts as social genres by investigating their operation within a context in terms of "sets of communicative purposes" (Askehave & Swales, 2001, p. 210). To date, ESP genre analysis has focused on a range of (social) genres from academic and professional domains, sometimes confining their analysis to one or more sections of texts belonging to these genres (such as the Introductions of research articles). The organizational structuring proposed is in terms of the staging of content (content schemata), identified in terms of *moves* and *steps*. Dudley-Evans (1994) suggests that "decisions about the classification of the moves are made on the basis of linguistic evidence, comprehension of the text and understanding of the expectations that both the general academic community and the particular discourse community have of the text" (p. 226). The moves and steps structures are then related to linguistic features that are commonly employed in their realization.

Within the ESP approach to genre, Methods sections of research reports have been described in some way by Bloor (1998), Brett (1994), Nwogu (1991) and Swales (1990), but to date only Lim (2006) appears to have attempted to provide a detailed move-and-step analysis linked to linguistic features, following the ESP approach to genre. Also, Swales and Feak (1994, 2000) also offer pedagogic advice to learner writers on the characteristics of types of Methods sections.

Swales (1990) does not provide an analysis of the content schemata of Methods section of research articles in terms of moves and steps. However, in reviewing the findings of investigations by sociologists (Gilbert & Mulkay, 1984; Myers, 1985) and linguists (Bruce, 1983; Weissberg, 1984), he notes general disciplinary differences between Methods sections in research reports in the physical sciences and those in social science or interdisciplinary fields, such as Applied Linguistics. In the former category, Methods sections showed a highly elliptical reporting where

coherence is achieved by a shared knowledge of investigative procedures and their likely sequence. Coherence is achieved by a ''cognitive but not discoursal development of the initial nominal group'' (Swales, 1990, p. 168). On the other hand he notes that Methods sections in social science reports of research showed ''careful step-by-step description massively supported by anaphoric reference and lexical repetition, producing the kind of explicitness that we associate with standard academic description'' (p. 169).

In published pedagogical materials, Swales and Feak (1994, p. 166, 2000, p. 206) characterize this broad difference between the two types of Methods sections in terms of *speed* or *density*. They say that in the case of social sciences (research areas that involve human subjects and human behavior), the Methods sections are *slow* or *extended*, and that in the case of the physical sciences (computer science, engineering and medicine), the Methods sections are *fast* or *condensed*. *Slowness* in research related to human subjects relates to the level of explanation that occurs within the Methods sections reporting this type of research. Bloor's (1998) small genre study confirms higher frequencies of examples, justifications and details in slow Methods sections.

While not specifically exploring the fast/slow distinction, Lim (2006) examined the Methods sections in 20 articles from two business management journals and proposed a schematic structure for the organization of their content in terms of three 'moves' and twelve 'steps' – some of the steps being further specified in terms of two or three sub-steps. His move-and-step analysis is summarized in Table 1.

Each of the steps is, in turn described, in terms of linguistic features that Lim sees as salient. (Because of the amount of linguistic information involved, these features are not included in Table 1.)

Thus, following the ESP approach to genre, Lim presents a meticulous investigation of his sample of 20 Methods sections with an extensive focus on the linguistic features that relate to the moves and steps that he identifies. However, two issues arise in respect of the ESP approach to textual analysis, such as that exemplified by Lim's investigation:

- the degree of specificity allowable in establishing content schemata for Methods sections, such as in terms of a move, step analysis; and,
- the pedagogical usefulness of linking features of the content schemata (moves and steps) to linguistic features for developing a writer's *capacity* (see Widdowson, 1983, p. 7).

In relation to the staging and organization of the content of Methods sections of his sample, Lim provides data indicating the actual occurrences of the 'steps' in the 20 articles for the sample (p. 7), but does not provide the

Table 1
Lim's (2006) move-and-step analysis of Methods sections of business management articles

Move 1: Describing the data collection procedure/s	Step 1: Describing the sample
	(a) Describing the location of the sample
	(b) Describing the size of the sample/population
	(c) Describing the characteristics of the sample
	Step 2: Recounting the steps in the data collection
	Step 3 Justifying the data collection procedures
	(a) Highlighting advantages of using the sample
	(b) Showing the representativeness of the sample
Move 2: Delineating procedure/s for measuring variables	Step 1: Presenting an overview of the design
	Step 2: Explaining the method/s of measuring variables
	(a) Specifying items in questionnaires/data bases
	(b) Defining variables
	(c) Describing methods of measuring variables
	Step 3: Justifying method/s of measuring variables
	(a) Citing previous research methods
	(b) Highlighting acceptability of the methods
Move 3: Elucidating data analysis procedure/s	Step 1: Relating data analysis procedures
	Step 2: Justifying the data analysis procedures
	Step 3: Previewing results

(Lim, 2006, p. 287).

same data about the higher level 'moves.' From the data provided, it seems that the 'steps' proposed occur on average in 65% of the sample and only three of the twelve steps occur in all 20 articles. This finding confirms the difficulty of establishing specific content schema patterns even in relatively conventionalized genres, such as research-reporting articles. This difficulty has been demonstrated by Paltridge (1993, 1997), who examined twelve introductions to research reports related to an environmental issue, attempting to establish a 'generic structure potential,' such as that proposed by Hasan (1989). Lim does not provide data about the occurrences of the higher level 'moves' in his sample although this may have been more pedagogically useful (in terms of generalizability to future situations of use).

The second issue that arises in relation to this type of analysis concerns the types of information presented in relation to moves and steps. In the case of the detailed analysis by Lim, this involves the identification of linguistic features seen as salient in the analysis. Table 2 is a summary of information proposed for Move 1, Step 1 in Lim's analysis.

This communicative aim of Move 1, Step 1 involves describing the sample, including its location, size and characteristics. In conjunction with this aim, lists of discrete linguistic items are provided; however, in this approach there is no focus on rhetorical discourse-organizing principles (as distinct from content-staging in moves and steps). For example, in Step 1 when describing the sample, this could involve considering the types of organizational knowledge used in discourse that presents non-sequential information.

Previous research appears to suggest that there is a problem in characterizing (social) genres (and their stages) in linguistic terms. For example, Biber (1989), on the basis of corpus research, claims (social) genres are "defined and distinguished on the basis of systematic, non-linguistic criteria" (p. 39). This view is also supported by Paltridge's (1993, 1997) study, which indicates that even in a relatively formulaic part-genre, writers will select from a wide range of linguistic resources. Therefore, while content schemata (such as moves and steps) and the linguistic features to which they are linked may provide part of the picture in terms of an approach to the analysis of exemplars (such as in Lim's study), it may also be the case that exemplars also need to be examined in terms of their use of more general discourse-organizing (*procedural*) knowledge, such as in relation to a single move or step or a schematic structure. The focus of the study reported here, therefore, is on the types of procedural knowledge (as operationalized by cognitive genres) that are employed in Methods sections.

1.3. Hypothesis

The tendencies for Methods sections reporting research in the social sciences to be characterized as *slow* (or *extended*), and those in the physical sciences, such as medicine and engineering, to be *fast* (or *compressed*) can be accounted for in their differential use of general discourse-organizing patterns, operationalizable as cognitive genres.

2. Methods

In order to investigate the use of cognitive genres in 'fast' methods sections from physical sciences research articles and 'slow' methods sections from the social sciences (Swales & Feak, 1994, p. 166, 2000, p. 206), two corpora of 30 Methods sections (one from each of the two subject categories) were created. To select the texts for the corpora, academics from one university and medical staff from one hospital (both institutions were in New Zealand) were asked

Table 2
Lim's (2006) example of linguistic features

Move 1	Step 1	Linguistic features
Describing the data collection procedure	Describing the sample (a) Describing the location of the sample (b) Describing the size of the sample/population (c) Describing the characteristics of the sample	Locative adjuncts e.g., *on the New York Stock Exchanges* Temporal adjuncts e.g., *at two time periods* Compositional verbs showing a relationship between an entity and its constituents or parts e.g., *comprise, constitute, contain, include* Independent clauses, past and present participial clauses, verbless adjective clauses, temporal adverbial clauses

(Summarized from Lim, 2006, pp. 287, 289).

to name the three or four journals in their field to which they most frequently refer, and Methods sections from articles published from the year 1999 were selected from the nominated journals. The criteria for the inclusion of a Methods section in the corpora was that the article from which it is drawn must report an actual research investigation and conform largely to the IMRD (Introduction, Method, Results, Discussion) structure in reporting the research. The two corpora were selected from the following subject areas (Table 3).

Corpus A consists of 28,612 words (tokens) and Corpus B, 29,148 words (tokens). A bibliography of the articles from which the two corpora are drawn is provided in Appendix A.

The Methods sections forming the corpora were scanned into plain text files and analyzed in two ways: first, they were rater-analyzed by the writer in relation to their use of the features of a model for cognitive genres and secondly by developing a wordlist and performing concordance searches of frequently occurring cohesive devices using Oxford Wordsmith Tools 4.0 (Scott, 2004).

2.1. The cognitive genre model for general discourse structures

Bruce (2005) proposes a model for four cognitive genres that are based generally upon the characteristics of the four *text types* that Biber (1989), as a result of a corpus study, found to occur most frequently in academic prose. However, in terms of their internal organizational structure, the cognitive genres are conceptualized in terms of cognitive, organizational knowledge rather than linguistic features. Drawing upon cognitive science and categorization theory, cognitive genres (as units of discourse) are proposed as types of highly complex category. The conceptualization of the cognitive genre model is constrained by the following key concepts from categorization theory:

- *schema theory* (Oller, 1995, pp. 284−287), which proposes that human knowledge of categories (even complex categories, such as types of discourse), exists in terms of idealized examples, such as a prototype;
- *prototype effect* (Rosch, 1978, pp. 40−41), which suggests that prototypes provide the basis for recognizing or creating examples of a particular category; and
- *hierarchy* (Brown, 1965, pp. 318−319), which proposes that the internal organization of complex units of knowledge, (in this case units of discourse), are organized in a 'top-down' manner − higher level general, to lower level specific structures.

The four different cognitive genres of the model (see Table 4) are based on the idea that category formation and organization (such as a category of discourse) is in response to human intention (see Barsalou, 1983; Murphy & Medin, 1985). Thus, the intentionality giving rise to the four cognitive genre categories relate to general rhetorical aims to represent certain types of knowledge within discourse; (see the *rhetorical focus* for each of the four types in Table 4).

Furthermore, drawing on the idea of hierarchy, the cognitive genre model employs a 'top-down' structure of cognitive systems for classification. These are: *gestalts* for ideas organization, *discourse patterns* for textual organization and *interpropositional relations* to structure more specific discourse elements to achieve cohesion and coherence.

At the upper levels of the model, the rhetorical purpose will engage a high-order, gestalt patterns termed *image schemata* (see Johnson, 1987) in order to broadly structure the content knowledge to be represented within the particular segment of text that realizes the cognitive genre. This is based on the idea that gestalts provide

Table 3
The two corpora

Corpus A (physical sciences)		Corpus B (social sciences)	
Number of Methods sections	Subject	Number of Methods sections	Subject
8	Biology	7	Applied Linguistics
7	Organic Chemistry	8	Education
8	Medicine (Paediatrics)	7	Sociology
7	Chemical Engineering	8	Psychology
30 (total)		30 (total)	

Table 4
Summary of the cognitive genre model

Report: static descriptive presentation	
Rhetorical focus	The presentation of data that is essentially non-sequential
Gestalt structure	WHOLE PART structure of which PART has an UP DOWN structure
Discourse pattern	Preview − details
Interpropositional relations	Amplification; reason−result, grounds−conclusion; simple contrast, comparative similarity, concession−contraexpectation, condition−consequence
Explanation: means-focused presentation	
Rhetorical focus	The presentation of information with the orientation on means
Gestalt structure	SOURCE PATH GOAL schema; LINK schema
Discourse pattern	Preview − details
Interpropositional relations	Means-purpose, means-result, amplification, concession−contraexpectation
Discussion: choice/outcome-focused presentation	
Rhetorical focus	The organization of data in relation to (possible) outcomes/conclusions/choices
Gestalt structure	CONTAINER schemata (more than one)
Discourse pattern	Generalization − examples and matching
Interpropositional relations	Grounds−conclusion, reason−result, means−purpose, means−result, concession−contraexpectation
Recount rhetorical type: sequential presentation	
Rhetorical focus	The presentation of data or information that is essentially sequential or chronological
Gestalt structure	SOURCE PATH GOAL schema
Discourse pattern	General − particular, problem solution
Interpropositional relations	Means-purpose, means-result, amplification, chronological sequence, grounds−conclusion, reason−result

(Bruce, 2005, p. 14).

a basis for structuring knowledge in the way proposed by Lakoff (1987, p. 283) in his *spatialization of form* hypothesis.

While gestalts (image schemata) refer to the general organization of concepts or ideas, in relation to the overall organization of the actual written text, they lead to the engagement of non-genre-specific discourse patterns (e.g., General−Particular, Problem−Solution), which have typical patterns of co-occurrence (Hoey, 1979, 1983, 1994, 2001).

The aim to communicate a particular rhetorical purpose will also influence selection from a specific set of lower-order cognitive categories termed *interpropositional relations* (Crombie, 1985). These always have two parts in that they involve a relation between two propositions, e.g., Reason Result, Condition Consequence, Chronological Sequence. Because these organizing structures involve propositional knowledge, they have a direct effect on linguistic organization and linguistic selection related to achieving cohesion and coherence within discourse.

2.2. The rater analysis

The author, as rater, analyzed each of the 60 texts of the two corpora for the occurrence of stretches of discourse that conformed to features of the cognitive genres proposed in the model. Analyses of the three levels of knowledge (gestalt structure, discourse patterns and interpropositional relations) were hand-written on each script (see Appendix B for an example of part of an analyzed script). Because cognitive genres are proposed as prototypical structures or tendencies, writers' individual use of the structure may vary from a close to a distant reflection of the model in terms of the degree of use of its features. This study did not attempt to grade the *degree of conformity* to the prototype in the analysis of the texts. The benchmark for classification used was where stretches of text appeared to conform *mainly* to the features of a particular cognitive genre, they were classified in terms of that category.

2.3. The corpus analysis

The purpose of the corpus analysis is to provide empirical data to compare with the findings of the rater analysis. Specifically the proposal for certain cognitive genre-characterizing interperpropositional relations is compared with

the corpus findings. Using the software *Oxford Wordsmith Tools 4.0* (Scott, 2004), a wordlist was generated for each corpus. From the most frequently items in the wordlists, cohesive devices (lexical and grammatical) were examined by concordance searches, including scrutiny of their contextual uses. The frequencies and particular uses of these cohesive devices are then compared with the interpropositional relation elements of the cognitive genres assigned by the rater analysis to each corpus.

3. Results

The rater analysis of the two corpora of Methods sections (in relation to the features of the cognitive genre model) found fairly consistent use of the Explanation cognitive genre in the fast (physical sciences) corpus and a combination of Recount and Report in the slow (social sciences) corpus. These findings are summarized in Table 5.

The number in parentheses shows number of occurrences of a cognitive genre within a Methods section. In some cases different cognitive genres are adjacent to each other (e.g., Corpus A, Text 4) or embedded within each other (e.g., Corpus B, Text 9)

3.1. Corpus A: physical sciences (fast) Methods sections

The rater analysis showed that the texts in Corpus A tend to use the Explanation cognitive genre of which the most frequently occurring interpropositional relations are Means Result and Means Purpose. These two relations are summarized in Table 6.

Table 5
The use of cognitive genres in Methods sections

Corpus A (physical sciences)		Corpus B (social sciences)	
Text 1	Explanation (3)	Text 1	Recount (1)
Text 2	Explanation (7)	Text 2	Recount (1) followed by Discussion (1)
Text 3	Recount (1)	Text 3	Recount (1)
Text 4	Explanation (3) Recount (1)	Text 4	Recount (6) containing embedded Report (1)
Text 5	Explanation (1) Recount (3)	Text 5	Recount (1)
Text 6	Explanation (4)	Text 6	Report (2) Recount (1) Discussion (1) Explanation (1)
Text 7	Explanation (5)	Text 7	Recount (1) Report (1)
Text 8	Explanation (5)	Text 8	Recount (1) Discussion (1)
Text 9	Explanation (1)	Text 9	Recount (1) containing embedded Reports (4)
Text 10	Explanation (3)	Text 10	Recount (1)
Text 11	Explanation (3)	Text 11	Recount (1) Explanation (1)
Text 12	Explanation (5)	Text 12	Recount (1)
Text 13	Explanation (3)	Text 13	Recount (1)
Text 14	Explanation (4)	Text 14	Recount (1)
Text 15	Explanation (8)	Text 15	Recount (2)
Text 16	Explanation (1)	Text 16	Recount (2) containing embedded Report (1)
Text 17	Recount (1)	Text 17	Recount (3) Report (1)
Text 18	Recount (1)	Text 18	Recount (1) Report (1) Explanation (1)
Text 19	Explanation (1) containing embedded Report (1)	Text 19	Recount (1) containing embedded Reports (2)
Text 20	Explanation (3)	Text 20	Recount (1) Report (1) Discussion (1)
Text 21	Recount (1) Explanation (1)	Text 21	Report (2) Recount (2)
Text 22	Explanation (1)	Text 22	Report (2) Explanation (1)
Text 23	Recount (1)	Text 23	Report (1) Recount (1)
Text 24	Explanation (1)	Text 24	Report (1) Recount (1)
Text 25	Explanation (4)	Text 25	Report (3) Recount (1)
Text 26	Explanation (1)	Text 26	Report (2) Recount (1)
Text 27	Explanation (1)	Text 27	Recount (1)
Text 28	Explanation (1)	Text 28	Recount (1) Report (1)
Text 29	Explanation (1)	Text 29	Report (3) Recount (1)
Text 30	Explanation (1)	Text 30	Recount (1) embedded Report (1) Discussion (1)

Table 6
Means-Purpose, Means-Result relations

Interpropositional relation	Description	Examples from the Corpus A
Means-Result	Involves a statement of *how* a particular result is/was/will be achieved.	Argon was purified *by* passing it through a series of columns (*order* Result Means)
Means-Purpose	Involves an action that is/was/will be undertaken *with the intention of* achieving a particular result (Crombie, 1985, p. 20)	Aliquots from the stock were used *for* preparing the working solutions (*order* Means Purpose)

The rater analysis of interpropositional relations in Corpus A texts found that the relations Means-Result and Means-Purpose together accounted for 40% of the total number of relations identified in the sample. This was followed by the relations of Chronological Sequence with 30% and Amplification with 16%.

To investigate these findings, Corpus A was examined by the use of the corpus software Oxford Wordsmith Tools 4.0 (Scott, 2004). Specifically a wordlist was generated and the most frequently occurring function words were identified; Table 8 shows the first 20 items of the wordlist generated for Corpus A (Table 7).

Swales (1990) emphasizes the importance of nouns or nominal groups in Methods sections in the physical sciences. Concordance searches of frequently occurring prepositions (from the wordlist) showed the several combined with verbs or nouns (or heading some other phrasal structure) were the most frequent signalers of 'means' and 'purpose' in the corpus. Table 8 shows the most frequent ways in which Means was signaled in this sample.

Table 9 following shows ways in which purpose was signaled in this sample, along with their frequencies of occurrence.

3.2. Corpus B: social sciences (slow) Methods sections

The rater analysis showed that the Methods sections in Corpus B employed mainly Recount but also incorporated Report cognitive genres, Report sometimes being added to or embedded within Recount as the overall organizer of the text. In the case of Recount, the model proposes that the one of the more frequently occurring interpropositional relations will be Chronological Sequence, and in the case of Report, the model proposes that one of the main interpropositional relations will be Amplification. The overall rater analysis of all the interpropositional relations in Corpus

Table 7
Corpus A − 'physical sciences wordlist'

Word	Number of occurrence	Number of texts
the	1209	30
of	778	30
and	649	30
were	497	30
a	466	30
was	460	30
in	417	30
to	377	30
with	250	30
for	248	29
at	234	29
by	180	28
from	151	28
as	135	27
on	121	28
an	90	28
or	89	20
used	84	26
using	79	24
after	74	21

Table 8
Occurrences of signalers of means in Corpus A

Signalers of means in Means-Result interpropositional relations identified in the cognitive analysis		Number of occurrences in the corpus (Wordsmith Tools 4.0 concordance search)
by (or by means of)	+ noun phrase (e.g., this was determined *by* independent generation of …) + Verb(ing) (e.g., Argon was purified *by passing* it though a series of columns.)	99 (25 texts)
using	+ noun phrase (e.g., corrections were made on 1.3 and 4, *using* semi empirical PSI scans)	79 (24 texts)
according to	+ noun phrase (e.g., the nuclei were released *according to* the method of Sgorbati et al.)	21 (14 texts)
as described	(elliptical structure) (e.g., Plants were grown essentially *as described* previously (Sauter, 1997))	22 (9 texts)
with	+ Noun phrase (e.g., Weight-based nitrogen concentrations were analysed…*with* a Kjeldahl method)	3 (3 texts)

B texts found that Amplification was the most frequently occurring relation, comprising 24% of the total number of relations identified in the sample. This was followed by Chronological Sequence with 12%, Means-Purpose 10% and Means-Result 8%.

The most frequently occurring relations − Amplification and Chronological sequence − are explained in Table 10.

Table 11 is the first part of the wordlist showing the 20 most frequently occurring function words.

The wordlist showed a high frequency of 'that.' A concordance search of the 219 occurrences of 'that' (including scrutiny of their contexts) found a high incidence of the Amplification relation using 'that.' Of those identified in the concordance occurrences, 123 introduced relative clauses and 65 introduced object noun clauses and 51 occurrences belong to other word classes. So, clearly, these types of structure are important and should be included in any linguistic focus in relation to slow Methods sections.

The rater analysis of Corpus B for instances of Chronological sequence showed a wide variety of ways in which this relation was signaled. For example, signaling chronology through the use and staging of verbs proved to be a commonly used device. These related to approximately half of the number of instances of Chronological sequence that were identified in the rater analysis, for example, "At times, I *posted* prompts to all the participants for open discussion, and the different perspectives I *received* from this discussion led to further interaction" (Corpus B, Text 3). Other common signalers of chronology in the corpus were adverbial phrases and clauses,

Table 9
Occurrences of signalers of purpose in Corpus A

Signalers of purpose in Means-Purpose interpropositional relations		Number of occurrences in the corpus
to	+ verb (infinitive) (e.g., beakers with the stem sections were placed in plastic cylinders *to* ensure high humidity)	74 (20 texts)
for	+ noun phrase (e.g., isolated stem sections were used *for* the analysis of hormonal and inhibitor effects) + verb (ing) (e.g., aliquots from the stock were used *for* preparing the working solutions)	61 (21 texts)
in order to	+ verb (e.g., the optical densities (OD's) of the sample and reference solutions… were matched *in order to* avoid different concentration variants of heat-producing transients)	6 (5 texts)

Table 10
Amplification, chronological sequence relations

Interpropositional relation	Description	Examples from the Corpus B
Amplification	This relation involves explicit or implicit repetition of the propositional content of one member of the relation in the other member, together with a non-contrastive addition to that propositional content (Crombie, 1985, p. 26).	The questionnaire data indicated a range of scores for the depression inventory that is normative… (restrictive and reduced relative clauses)

The women knew that I was exploring the issues of women and minorities in science… (noun clauses as the object of a sentence) |
| Chronological sequence | The relation of Chronological Sequence provides the semantic link between event propositions own of which follows the other in time (Crombie, 1985, p. 18). | I *started* the initial interviews with general questions about each participant's educational background and professional experiences. I *then* asked the participants what the label non native-English-speaking TESOL professional meant to them… |

for example, "A month later" (Corpus B, Text 7) and noun groups, such as "a follow-up content analysis" (Corpus B, Text 10).

4. Discussion

The examination of two small corpora of Methods sections in this study suggests that Swales and Feak's (1994, 2000) characterization of general disciplinary differences of fast (condensed) Methods sections found in physical sciences research reports and slow (extended) Methods sections in social sciences may be further accounted for by the different types of cognitive genres employed. In the physical sciences, Methods sections appear to use compact, means-focused structures (operationalized by the Explanation cognitive genre in this study), while in the social sciences Methods sections appear to employ chronology-focused structures elaborated by information-reporting structures (operationalized here by Recount and Report). However, because the samples used were small and multi-rater analysis of the cognitive genre patterns was not possible, the findings from the study can be only considered indicative. In the discussion that follows, possible implications of the findings will be discussed in relation to two areas:

Table 11
Corpus B — 'social sciences' wordlist

Word	Number of occurrence	Number of texts
the	1898	30
of	1161	30
and	859	30
to	690	30
in	687	30
a	534	30
were	459	30
for	313	29
was	242	30
as	228	28
that	219	29
on	186	29
with	179	29
their	176	26
students	171	19
from	167	27
by	162	28
or	137	27
this	124	29
each	52	15

1. pedagogical implications for those engaged in the teaching of the writing of Methods sections; and
2. wider implications for conceptualizing genres.

In relation to pedagogy, it is suggested that genre knowledge is used in two areas of activity: to provide a heuristic for the analysis of further texts (of the same genre) and to assist writers to acquire the means to create their own texts within the same discipline.

The focus of this study has not been on the social genre elements of Methods sections, but rather the consequences of these influences in the structured textual outcomes that they produce. However, genre-based pedagogy that attempts to teach the writing of Methods sections should clearly include a focus on both the social and cognitive genre dimensions of discourse or, as Swales (1990) puts it, ''what is sayable and how and when it is sayable'' (p. 88). In relation to pedagogy, it is suggested here that when examining the Methods section of a particular discipline, it is salient to first examine the surrounding social genre influences in order to establish a grounded view of this part-genre. As proposed previously this may involve consideration of discipline-specific issues of context, content, epistemology, writer stance as well as addressivity and audience. This can then be followed by deconstructing and practising the cognitive genre elements of exemplar texts which, it is proposed, will assist in providing writers with tools to achieve finer grained analysis of the textual elements of Methods sections in particular disciplines as well as the procedural knowledge necessary to create their own.

Existing guidance for teaching Methods sections, such as the two Swales and Feak (1994, 2000) books, Bloor's (1998) study and Swales' (1990, 2004) ERP books, establish the slow/fast (condensed/extended) tendencies of Methods sections and provide information about linguistic and stylistic features of these two tendencies. However, the approach here sees that the two Methods sections tendencies could also be considered in terms of the differing cognitive genre resources employed. Possible insights from the cognitive genre analysis of Methods section that could be included in writing instruction are summarized in Table 12.

In relation to genre theory generally, this study attempts to present a further challenge to a unitary approach to operationalizing genre in terms of a generic structure (or a move-and-step structure) to account for the staging of content linked to discrete items of lexis, grammar and syntax. The unitary approach may relate to what Widdowson (1983) refers to developing learner writers' *competence* (involving social rules and linguistic systems) rather than their *capacity*, which requires the development of procedural knowledge, such as those operationalized in this study by the cognitive genre model. Biber (1989), Paltridge (2002) and Pilegaard and Frandsen (1996) all propose that an adequate theory of discourse categorization involves a dual approach involving both socially constructed genre knowledge and more general, rhetorical knowledge. The social genre/cognitive genre approach employed here further advances their ideas in terms of operationalizing the different types of knowledge involved for pedagogical purposes. In the case of Methods sections examined in this study, it appears that understanding the cognitive genre resources employed in this part-genre is an important element of the procedural knowledge required to be able to analyze existing texts and create new examples of this part-genre.

Table 12
General rhetorical features of fast and slow Methods sections

	Fast Methods section	Slow Methods sections
Ideas organization	Chronological — chronology implied by the causal links between the interdependent steps in the process	Overall ideas organization is chronological (linguistically signaled), Chronological organization may include or be adjacent to non-chronological text segments (which are organized hierarchically if they include quantitative data).
Textual organization	Textual organization *Preview details* Heading previews only followed by the details stage of the process. Preview details sections are often recursive.	Textual organization *General particular structure (Preview Details)* The preview section is a concise but comprehensive summary or overview of the research methodology. The details section can include elaborate descriptive asides — such as describing the sample.
Coherence and cohesion	Lexical (rather than grammatical) markers of the causal relations of means, purpose, reason and to a lesser extent condition carry much of the cohesive load (see Tables 9 and 10).	Strong emphasis on descriptive elaboration using hypotactic structures — defining relative clauses, reduced relative clauses and object noun clauses

Appendix A. The corpora

Corpus A. Physical sciences articles

Corpus item	Subject	Journal/text	Year, volume, issue, pages	Article	Author
1.	Biology	New Phytologist	(1999), 141, 3, pp. 401−409	Generalities in the growth, allocation and leaf quality responses to elevated CO_2 in eight woody species	J. H. C. Cornelissen, A. L. Carnell & T. V. Callaghan
2.	Biology	New Phytologist	(1999), 142, 1, pp. 5−17	Emissions, biogenesis and metabolic utilization of chloromethane by tubers of the potato (*Solanum tuberosum*)	David B. Harper, Barbara M. R. Harvey, Maurice R. Jeffers & James T. Kennedy
3.	Biology	Nature	(1999), June 17, pp. 686−688	Jasmonate-inducible plant defences cause increased parasitism of herbivores	J. S Thaler
4.	Biology	Nature	(1999), July 8, pp. 152−155	Nitrogen oxide emissions after nitrogen additions in tropical forests	Sharon J. Hall & Pamela A. Matson
5.	Biology	Nature	(1999), July 22, pp. 358−360	Environmental determination of a sexually selected trait	Simon C. Griffith, Ian P. F. Owens & Terry Burke
6.	Biology	Plant Physiology	(1999), 119, 1, pp. 21−29	Adventitious root growth and cell cycle induction in deepwater rice	Rene Lorbiecke & Margret Sauter
7.	Biology	Plant Physiology	(1999), 121, 3, pp. 345−351	A point mutation in the ethylene-inducing xylanase elicitor	Noa Furman-Matarasso, Eitan Cohen, Quansheng Du, Nor Chejanovsky, Uri Hanaia, & Adi Avni
8.	Biology	Plant Physiology	(1999), 122, 1, pp. 107−116	Altering expression of cinnamic acid 4-hydroxylase in transgenic plants provides evidence for a feedback loop at the entry point into the phenylpropanoid pathway	Jack W. Blount, Kenneth L. Korth, Sameer A. Masoud, Susanne Rasmussen, Chris lamb & Richard A. Dixon
9.	Chemistry	Analytica Chimica Acta	(1999), 391, 1, pp. 83−88	Simultaneous quantitative determination of diazepam and liposomes using differential pulse polarography	Christos G. Kontoyannis, Sophia G. Antimisiaris & Dionisis Douroumis
10.	Chemistry	Analytica Chimica Acta	(1999), 391, 3, pp. 277−288	Qualitative and quantitative determination of oxygenates in gasolines using ^{1}H nuclear magnetic resonance spectroscopy	Reinhard Meusinger
11.	Chemistry	Analytica Chimica Acta	(1999), 391, 3, pp. 265−274	Evaluation of a chemical vapour dosimeter using polymer-coated SERS substrates	David L. Stokes, Anjali Pal, V. Anantha Narayanan, & Tuan Vo-Dinh
12.	Chemistry	Journal of Organometallic Chemistry	(1999), 588, 42−50	Solid state structural and solution studies on bis (2-methylbenzyl)-selenide, methyl (2,4,6-tri-*tert*-butylphenyl)-selenide, bis (2,4,6-tri-methylphenyl (-diselenide, and bis (2,4,6-tri-*tert*-butylphenyl)-diselenide	Paul M. Dickson, Margaret A. D. McGowan, Burl Yearwood, Mary Jane Heeg & Honhn P. Oliver

Appendix A (*continued*)

Corpus item	Subject	Journal/text	Year, volume, issue, pages	Article	Author
13.	Chemistry	Journal of Organometallic Chemistry	(1999), 588, 155–159	A new synthesis of chloroheterocycles via metal–halogen exchanges between trichloroacetyl derivatives and heteroaromatic lithium and Grignard reagents	Carl Boga, Erminia Del Vecchio, Luciano Forlani, Lilia Milanesi, & Paolo Edgardo Todesco
14.	Chemistry	Journal of Organic Chemistry	(1999), 64, 2, pp. 427–431	α-C–H Bond Dissociation Energies of Some Tertiary Amines	G. W. Dombrowski, J. P. Dinnocenzo, S. Fardi, J. L. Goodman & I. R Gould
15.	Chemistry	Journal of Organic Chemistry	(1999), 64, 2, pp. 9374–9380	Palladium-catalyzed asymmetric allylic substitution reactions using new chiral phosphinite-oxazoline ligands derived from D-glucosamine	Kji Yonehara, Tomohiro Hashizume, Kenji Mori, Kouichi Ohe & Sakae Uemura
16.	Pediatrics	The Journal of Pediatrics	(1998), 133, 5, pp. 613–616	Occult nitric oxide inhalation improves oxygenation in mechanically ventilated children	Lucy C. S. Lum, Patrick S. K. Tan, Al Saville, Shekar T. Venkataraman & Michael R. Pinsky
17.	Paediatrics	The Journal of Pediatrics	(1999), 135, 6, pp. 6683–685	Respiratory illness after sever respiratory syncytial virus disease in infancy in The Gambia	Martin W. Weber, Paul Milligan, Barinada Giadom, Muhammed A. Pater, Awewura Kwara, Abubakar D. Sadiq, Martin Chanayireb, Hilton Whillte, Brain M. Greenwood, & Kim Mulholland
18.	Paediatrics	The Journal of Pediatrics	(2000), 136, 1 pp. 24–29	Long-term outcome of peritoneal dialysis in infants	Sarah E. Ledermann, Maria E. Scanes, Oswald N. Fernando, Patrick g. Duffy, Shelagh J. Madden & Richard S. Trompeter
19.	Paediatrics	Archives of Disease in Childhood: Journal of the Royal College of Pediatrics and Child Health	(1999), 80, 3, pp. 248–252	Surfactant treatment for acute respiratory distress syndrome	Jésus López-Herce, Nieves de Lucas, Angel Carillo, Amaya Bustinza, & Ramon Moral
20.	Paediatrics	Archives of Disease in Childhood: Journal of the Royal College of Pediatrics and Child Health	(1999), 80, pp. 311–317	Survival after acute lymphocytic leukaemia: effects of socioeconomic status and geographic region	Julia A. Schillinger, Pascale C. Grosclaude, Satoshi Honjo, Michael J. Quinn, Andy Sloggett, & Michel P. Coleman
21.	Paediatrics	Archives of Disease in Childhood: Journal of the Royal College of Pediatrics and Child Health	(2000), 82, pp. 126–130	Randomised placebo controlled trial of nebulised corticosteroids in acute respiratory syncytial viral bronchiolitis	A Cade, K .G Brownlee, S. P. Conway, D. Haigh, A. Short, J Brown, D. Dassu, S. A. Mason, A. Phillips, R. Eglin, M. Graham, A. Chetcuti, M. Chatrath, N. Hudson, A. Thomas & P. A. J. Chetcuti
22.	Paediatrics	New Zealand Medical Journal	(1999), 119, 1093–1096	Unexplained fainting, near drowning and unusual seizures in Childhood: Screening for long QT syndrome in New Zealand families	Tim Bradley, Joanne Dixon & Ron Easthope
23.	Paediatrics	New Zealand Medical Journal	(2000), 113, 1102, pp. 8–10	Changes to infant sleep practices in Canterbury	P. K. Ford, P. J. Schluter, & S. Cowan

Appendix A (*continued*)

Corpus item	Subject	Journal/text	Year, volume, issue, pages	Article	Author
24.	Chemical Engineering	Chemical Engineering Science	(1999), 54, 271–280	Particle transport in microflow crossfiltration − I. Effects of hydrodynamics and diffusion	I. H. Hiusman, & C. Trägårdh
25.	Chemical Engineering	Chemical Engineering Science	(1999), 54, 369–375	The effects of electrostatic interactions on the rejection of colloids by membrane pores − visualisation and quantification	W. Richard Bowen, Nidal Hilal, Mohit Jain, Robert W. Lovitt, Adel O. Sharif, & Chris J. Wright
26.	Chemical Engineering	Chemical Engineering Science	(1999), 54, 455–459	Measurement of solids velocity in a conical Hopper by mass tracer particles	H.-Y. Xie, & K. Shinohara
27.	Chemical Engineering	Separation and Purification Technology	(1999), 16, 213–224	Aqueous phase adsorption of certain beta-lactam antibiotics onto polymeric resins and activated carbon	M. Dutta, N. N. Dutta, & K. G. Bhattacharya
28.	Chemical Engineering	Separation and Purification Technology	(1999), 17, 21–30	Reusable adsorbents for dilute solution separation 3. Sorption dynamics of phenanthrene on surfactant-modified alumina	P. J. Jain, J. S. Smith, & K. T. Valsaraj
29.	Chemical Engineering	Meat Science	(1999), 51, 123–128	Lipolytic and oxidative changes in two Spanish pork loin products: dry-cured loin and pickled-cured loin	Pilar Hernández, J. L. Navarro, & F. Toldrá
30.	Chemical Engineering	Meat Science	(1999), 51, 283–288	Muscle composition and fatty acid profile in lambs fattened in drylot or pasture	A Rowe, F. A. F. Macdeo, J. V. Visentainer, N. E. Souza, & M. Matsushita

Corpus B: Social sciences articles

Corpus item	Subject	Journal/text	Volume, issue, pages	Article	Author
1.	Applied Linguistics	Applied Linguistics	(1999), 20, 3, pp. 341–367	Academic attribution: Citation and the construction of disciplinary knowledge	Ken Hyland
2.	Applied Linguistics	Applied Linguistics	(1999), 20, 1, pp. 1–21	Procedural vocabulary: Lexical signalling of conceptual relations in discourse	Maria Jose Luzon Marco
3.	Applied Linguistics	Applied Linguistics	(1999), 13, 1, pp. 85–102	Nonnative-English-Speaking Professions in TESOL	Jun Liu
4.	Applied Linguistics	English for Specific Purposes	(1999), 18, 161–175	The English vocabulary knowledge of Indonesian university students	Ari Nurweni & John Read
5.	Applied Linguistics	English for Specific Purposes	(1999), 18, 1, 63–80	Discourse in MBA seminars: Towards a description for pedagogical purposes	Helen Basturkmen
6.	Applied Linguistics	Journal of Second Language Writing	(1999), 8, 1, 13–44	The use of restructuring strategies in EFL writing: A study of Spanish learners of English as a foreign language	Julio Roca De Larios, Liz Murphy, & Rosa Manchon
7.	Applied Linguistics	Journal of Second Language Writing	(1999), 9, 2, 123–145	Using computer-tagged linguistic features to describe l2 Writing differences	Leslie Grant, & April Ginther
8.	Education	Research in Science Education	(1999), 29, 1, pp. 69–88	Educating science teachers for the sociocultural diversity of urban schools	Kenneth Tobin, Gale Seiler & Mackenzie W. Smith

Appendix A (*continued*)

Corpus item	Subject	Journal/text	Volume, issue, pages	Article	Author
9.	Education	Research in Science Education	(1999), 29, 4, pp. 457–477	Assessing depth of socio-cognitive processing in peer groups' science discussions	Kathleen Hogan
10.	Education	Research in Science Education	(2000), 30, 1, pp. 141–154	Prospective elementary science teachers and biomythographies: An exploratory approach to autobiographical research	Sharon E. Nichols & Deborah J. Tippins
11.	Education	Journal of Research in Science Teaching	(1999), 36, 4, pp. 455–473	Factors associated with students' intentions to engage in science learning activities	Malcolm B. Butler
12.	Education	Journal of Research in Science Teaching	(1999), 36, 6, pp. 621–636	Multiple worlds/mismatched meanings: Barriers to minority women engineers	Pauline W. U. Chinn
13.	Education	New Zealand Science Teacher	(1999), 93, pp. 28–31	"Those pages we just turn over …" The 'nature of science' in Science in the New Zealand Curriculum	Mary Loveless & Miles Barker
14.	Education	New Zealand Science Teacher	(1999), 95, pp. 6–10	The state of Earth Science education in New Zealand secondary schools	Paul W. O. Hoskin
15.	Education	New Zealand Science Teacher	(1999). 109, pp. 15–18	Does teaching "How to Learn" matter"	Azra Moeed & Matthew Easterbrook
16.	Sociology	Journal of Marriage and the Family	(1999), 61, 1, pp. 21–37	Transmission of emotions in the daily interactions of single-mother families	Reed W. Larson & Sally Gillman
17.	Sociology	Journal of Marriage and the Family	(1999), 61, 1, pp. 38–48	Emotional transmission in couples under stress	Anne Thompson & Niall Bolger
18.	Sociology	Journal of Marriage and the Family	(1999), 61, 1, pp. 49–61	Daily transmission of tensions between marital dyads and parent-child dyads	David M. Almeida, Elaine Wethington & Amy L. Chandler
19.	Sociology	Social Policy Journal of New Zealand	(1999, July), 106	Hippy New Zealand: An evaluation overview	BarHava-Monteith, Galia, Harre, Niki, & Field, Jeff
20.	Sociology	Social Policy Journal of New Zealand	(1999, December), 13, 115–135	Health care needs for older adults	Ross A. Flett, Nikolaos Kazantzis, Nigel R. Long, Michelle A. Millar & Carol MacDonald
21.	Sociology	Journal of Child and Family Studies	(1999), 8, 1	Anxiety symptomatology in Mexican-American Adolescents	Saundra H. Glover, Andres J. Pumariega, Charles E. Holzer, Brian K. Wise, & Moises Rodriguez
22.	Sociology	Journal of Child and Family Studies	(1999), 8, 2, 169–180	Strengths-based assessment of children with SED: Consistency of reporting by teachers and parents	Karen A. Friedman, Peter E. Leone, & Philip Friedman
23.	Psychology	Journal of Cross-cultural Psychology	(1999), 30, 4, pp. 422–442	Towards a more complex understanding of acculturation and adjustment: Cultural involvements and psycho-social functioning in Vietnamese youth	Hwong H. Nguyen, Lawrence A. Messé, & Gary E. Stollak
24.	Psychology	Journal of Cross-cultural Psychology	(1999), 30, 1, pp. 5–31	Acculturation and adaptation revisited	Colleen Ward & Arzu Rana-Deuba
25.	Psychology	Journal of Cross-cultural Psychology	(1999), 30, 4, pp. 501–526	Organizational culture and human resource management practices: The model of culture fit	Zeynep Aycan, Rabindra N. Kanungo & Jai B. P. Sinha
26.	Psychology	Educational and Psychological Measurement	(1999, February), 59, pp. 77–97	Taking the strain out of negative affectivity: Development and initial validation of scores on a strain-free measure of negative affectivity	Vincent J. Fortunato & Eugene F. Stone-Romero
27.	Psychology	Educational and Psychological Measurement	(1999), 59, 6, pp. 951–961	How selective are psychology graduate programs? The effect of the selection ration of GRE score validity	Oleksandr S. Chernyshenko

Appendix A (*continued*)

Corpus item	Subject	Journal/text	Volume, issue, pages	Article	Author
28.	Psychology	Asian Journal of Social Psychology	(1999), 2, 79−93	Social identity and the crisis of confidence on social psychology: A commentary, and some research on uncertainty reduction	Michael A. Hogg & Paul Grieve
29.	Psychology	Asian Journal of Social Psychology	(1999), 2, 237−244	Managing attitudes toward high achievers: The influence of group discussion	Stuart C. Carr, Ian P. Purcell & Floyd H. Bolitho
30.	Psychology	Personality and Psychology Bulletin	(1999), 25, 2, pp. 225−236	Stereotype accuracy: Estimating academic performance of ethic groups	Michael C. Ashton & Victoria M. Esses

Appendix B. Example of part of a script analyzed using the cognitive genre model

Gestalt Structure	Discourse Pattern	Text	Interpropositional Relations
Source	*Preview*	MATERIALS AND METHODS Plant Material and Incubation Conditions	
Path	*Details*	Seeds of deepwater rice (Oryza sativa L. cv Pin Gaew 56) were obtained* from the International Rice Research Institute (Los Banos, The Philippines). Plants were grown essentially as described previously (Sauter, 1997) for 12 to 14 weeks. Whole plants were submerged in 600-L plastic tanks filled with tap water at 25°C with approximately 30 cm of the leaf tips remaining above water. Incubation was in an environmental growth chamber under continuous light (200 iLE m-2 S-l). Control plants were kept in the same growth chamber. Isolated stem sections were used for the analysis of hormonal and inhibitor effects on adventitious root growth at the third node. The sections were cut from 2 cm below the third-highest node extending upward, with a total length of 20 cm. The sections contained the third and second nodes and the second-youngest internode between them. The sections were incubated in 150-mL beakers containing 25 mL of an aqueous solution of the appropriate hormones: lA A, GA3, 6-BA, hormone precursors, ethephon (2-chlorethanephosphoric acid), or ACC at the concentrations indicated	Chronological Sequence Result Means Amplification Temporal Overlap Means — Bonding Purpose Bonding Chronological Sequence Bonding

(Corpus A, Text 3).

* Underlined words indicate signalers of interpropositional relations.

References

Askehave, I., & Swales, J. M. (2001). Genre identification and communicative purpose. *Applied Linguistics, 22*, 195−212.

Barsalou, L. W. (1983). Ad hoc categories. *Memory and Cognition, 11*, 211−227.

Biber, D. (1989). A typology of English text. *Linguistics, 27*, 3−43.

Bloor, M. (1998). Variations in the methods sections of research articles across disciplines: The case of fast and slow text. In P. Thompson (Ed.), *Issues in EAP writing, research and instruction* (pp. 84−106). Reading, UK: CALS, The University of Reading.

Brett, P. (1994). A genre analysis of the results section of sociology articles. *English for Specific Purposes, 13*, 47−59.

Brown, R. (1965). *Social psychology*. New York: Free Press.

Bruce, I. J. (2005). Syllabus design for general EAP courses: a cognitive approach. *Journal of English for Academic Purposes, 4*(3), 239−256.

Bruce, N. J. (1983, August). *Rhetorical constraints on information structure in medical research report writing*. Paper presented at the ESP in the Arab World Conference, University of Aston, UK.

Crombie, W. H. (1985). *Process and relation in discourse and language learning*. Oxford: Oxford University Press.

Dudley-Evans, T. (1994). Genre analysis: an approach to text analysis for ESP. In M. Coultard (Ed.), *Advances in written text analysis* (pp. 219−228). London: Routledge.

Gilbert, G. N., & Mulkay, N. (1984). *Opening Pandora's box: A sociological analysis of scientific discourse*. Cambridge: Cambridge University Press.

Hasan, R. (1989). The identify of a text. In M. A. K. Halliday, & R. Hasan (Eds.), *Language, text and context* (pp. 97−118). Oxford: Oxford University Press, [Original work published in 1985].

Hoey, M. (1979). *Signalling in discourse*. Discourse analysis monograph no. 6. Birmingham: English Language Research, University of Birmingham.

Hoey, M. (1983). *On the surface of discourse*. London: George Allen & Unwin.

Hoey, M. (1994). Signalling in discourse: A functional analysis of a common discourse pattern in written and spoken English. In M. Coulthard (Ed.), *Advances in written text analysis* (pp. 26−45). London: Routledge.

Hoey, M. (2001). *Textual interaction: An introduction to written discourse analysis*. London: Routledge.

Johnson, M. (1987). *The body in the mind: The bodily basis of meaning, imagination, and reason*. Chicago: University of Chicago Press.

Lakoff, G. (1987). *Women, fire and dangerous things: What categories reveal about the mind*. Chicago: Chicago University Press.

Lim, J. M. H. (2006). Method sections of management research articles: a pedagogically motivated qualitative study. *English for Specific Purposes, 25*(3), 282−309.

Murphy, G. L., & Medin, D. L. (1985). The role of theories of conceptual coherence. *Psychological Review, 92*, 289−316.

Myers, G. (1985). Texts as knowledge claims: the social construction of two biology articles. *Social Studies of Science, 15*, 593−630.

Nwogu, K. N. (1991). Structure of science popularisations: A genre-analysis approach to the schema of popularised medical texts. *English for Specific Purposes, 10*, 111−123.

Oller, J. W. (1995). Adding abstract to formal and content schemata: Results of recent work in Peircean semiotics. *Applied Linguistics, 16*, 273−306.

Paltridge, B. R. (1993). A challenge to the current concept of genre: Writing up research. Unpublished doctoral dissertation, University of Waikato, Hamilton, New Zealand.

Paltridge, B. (1997). *Genre, frames and writing in research settings*. Amsterdam: John Benjamins.

Paltridge, B. (2002). Thesis and dissertation writing: an examination of published advice and actual practice. *English for Specific Purposes, 21*, 125−143.

Pilegaard, M., & Frandsen, F. (1996). Text type. In J. Verschueren, J.-O. Ostaman, J. Blommaert, & C. C. Bulcaen (Eds.), *Handbook of pragmatics* (pp. 1−13). Amsterdam: John Benjamins.

Rosch, E. (1978). Principles of categorisation. In E. Rosch, & B. B. Lloyd (Eds.), *Cognition and categorization* (pp. 27−47). Hillsdale, NJ: Erlbaum.

Scott, M. (2004). *Oxford Wordsmith tools 4.0*. [Computer software]. Oxford, UK: Oxford University Press.

Swales, J. M. (1990). *Genre analysis: English in academic and research settings*. Cambridge: Cambridge University Press.

Swales, J. M. (2004). *Research genres: Exploration and applications*. Cambridge: Cambridge University Press.

Swales, J. M., & Feak, C. (1994). *Academic writing for graduate students*. Ann Arbor: University of Michigan Press.

Swales, J. M., & Feak, C. (2000). *English in today's research world*. Ann Arbor: University of Michigan Press.

Weissberg, R. C. (1984). Given and new: Paragraph development models from scientific English. *TESOL Quarterly, 18*(3), 485−500.

Widdowson, H. (1983). *Learning purpose and language use*. Oxford: Oxford University Press.

Ian Bruce is a lecturer in applied linguistics at the University of Waikato, Hamilton, New Zealand. His research interests relate to applying genre theory to the teaching of academic writing. He has contributed to several curriculum design projects for the New Zealand Ministry of Education.