Social pragmatics in technical writing: A corpus-based analysis of thematic articles

Camen Pérez-Llantada Auría
Universidad de Zaragoza

Abstract

The main objective of this paper is to analyse some sociocultural implications involved in the process of technical writing. In particular, the analysis will focus on those socially and ideologically-related rhetorical mechanisms of linguistic interaction that engineers use when writing thematic articles. As a selected corpus maps out, concepts such as ideology, power, politeness or a persuasive rhetoric prove to be key factors in determining the appropriate linguistic choices in those social interactions within this community. In the light of social pragmatics, the extent to which institutional and cultural factors affect research writing in the field of technology will therefore call for a redefinition of the 'classical' objectivity sought in these specialised discourse practices.

Key words: discourse analysis, pragmatics, English for Science and Technology, register analysis, sociology of disciplinary knowledge

Resumen

El propósito de este artículo es el de analizar diversas consideraciones socioculturales implícitas en el propio proceso de escritura técnica. El análisis se centra en aquellos mecanismos retóricos de interacción lingüística empleados en los artículos temáticos técnicos pues se hacen eco de implicaciones sociales de la propia comunidad discursiva. Como ilustra el corpus seleccionado para el análisis, el marco ideológico e institucional en el que se incribe este subgénero, la dimensión social del discurso y la retórica como recurso para la eficacia comunicativa son factores determinantes para la selección lingüística de este tipo de textos especializados. Desde una perspectiva pragmática, todos estos

parámetros de interacción social demuestran la necesidad de replantear el concepto clásico de "objetividad" en los discursos para fines especializados.

Palabras clave: análisis del discurso, pragmática, inglés para la ciencia y la tecnología, análisis del registro, sociología del conocimiento disciplinar.

Introduction

At the beginning of the third millenium English stands as the international language of scientific and technical research disciplines, as it is the main language used in international symposia, conferences or seminars, as well as in those specialised publications where scientists and engineers present their claims. In particular, English in technical communication stands as a highly constricted specialised register or, as the sociolinguists Biber and Finegan (1994: 4) put it, "a language variety viewed with respect to its context of use." This context of use comprises a set of recurrent social interactions that take place within this particular community of researchers. In this community, its members share common linguistic and genre conventions for effective communication in both written and oral practices –as authors like Swales (1990) or Bathia (1993) have pointed out.

Indeed, as a self-contained register, technical communication complies with certain linguistic and discourse parameters of social interaction. According to well-known guides on style and rhetoric, like those of Barras (1978), Day (1979), Hamp-Lyons and Heasley (1987), objectivity should prevail in the presentation of technical claims. To do so, the language used to transmit technical information should follow what is known as the "CBS style" (Scollon & Scollon, 1995: 98) –clarity, brevity and sincerity–, as what is sought is ultimately the validity and the acceptability of the scientific reasoning presented.

However, according to more recent approaches to technical writing (Wilkinson 1991; Eisenberg, 1993; Rollinson, 1996), conventions in writing are not only regarded in terms of contents but also with reference to the presentation of these contents. In the light of these approaches, it appears that there is a need for further insights on the topic of rhetoric and interdisciplinary variation of technical genres to understand the social and pragmatic implications involved in building up the formal architecture of technical communication. This article attempts to analyse a corpus of technical texts

and outline several discoursal and rhetorical features that can provide evidence of the social aspects of this particular disciplinary discourse. The corpus selected comprises ten thematic articles from *Computing in Science and Engineering*, a well-known specialised IEEE Computer Society publication, and a regular subscription at the Technological Campus Library of the Zaragoza University (Spain). Thematic articles[1] have been chosen for the study as analyses on technical discourse are mostly devoted to the classical research written genres like abstracts and research articles[1], whereas the sub-genre of thematic articles is hardly covered. In addition, three other criteria have been considered: their intended audience, their recent date of publication and the social issues they address, the latter being regarded as the most outstanding feature of this sub-genre. As for the first criterion, this sub-genre is addressed to a particular community –physical scientists, engineers, mathematicians and other researchers involved in computational methodologies. Secondly, the ten selected articles correspond to the first two issues of the year 2002, and may therefore help us to analyse the most recent trends in specialised writing. Finally, the topics that these monographic publications cover are sociologically relevant as they deal with two contemporary affairs, namely biocomputation and high-performance computing and national security. Only research writing –and no popularizations– has been included in the corpus to further assess how these specialists-researchers in the field implicitly assume certain pragmatic rules and how disciplinary discourses as that of technology are understood as rhetorical and provisional, as recent studies in academic rhetoric point out (Hyland, 2000; Flowerdew, 2002). Only introductory and concluding sections of these articles will be the focus of the present analysis. To provide evidence of the social and institutional implications entailed in textual practices, the analysis will attempt to illustrate a recurrent use of the following pragmatic features: rhetorical moves in introductions, the role of discourse markers for rhetorical signposting, epistemic modality or writer's stance, persuasion and argumentation, hedging and pragmatic politeness.

Introductions in Thematic Articles Rhetorical Moves

As a social group, any interpretive community is characterized by a relative homogeneity in its theoretical thought (Alcaraz, 2000: 21). Researchers in the fields of engineering and technology share common mental and conceptual sets of associated information –called "cognitive schemata" (Yule, 1996: 85)–, which are predictable expectations of formal

patterns specific in this particular community of language users. Tannen and Wallat also remark that "all participants in the interaction collaborate in the negotiation of all frames operative within that interaction" (1999: 356), and "what individuals choose to say in an interaction grows out of multiple knowledge schemas regarding the issues under discussion, the participants, the settings, and so on" (1999: 363). It is the task of the researcher-writer to encode meanings in this specialised register bearing in mind the audience's mental and conceptual mappings. Likewise, it is the task of the reader to go through complex inferential processes and contextualize information by using these previous cognitive mappings. As the corpus illustrates, the introductory sections of the articles display a preference for the use of a recurrent schema for content organization in technical writing, the so called problem-solution pattern (Hoey, 1985; Weissberg & Buker, 1990). This structural framework consists of an introduction or general background information, the statement of a problem –a need, a lack, a disadvantage, etc.–, its corresponding solution and the evaluation of the results. This discourse pattern provides a consistent structural framework to develop ideas logically and coherently, and is thus broadly used in specialised writing. By way of illustration, the ten articles included in the corpus start with an introduction or presentation of background information –mostly in the present tense–, which moves from a general statement to particular details specifying the procedure, method, or application under concern. Often references to previous literature or research about the topic are included in the introduction. These references usually appear in the past or present perfect tenses and serve to demonstrate the readership that researchers know or have read about former research; some examples from the corpus are, for instance, references such as "traditional models and simulations" (Alur et al., 2002: 20), "many researchers have undertaken ..." (Xu et al., 2002: 50), "historically, the military has used ..." (Schraml et al., 2002: 16).

Precisely, the revision of previous bibliography or studies becomes, in the ten articles, the source of a problem or gap which is to be solved by the authors' current research. Vos's (2002: 66) introduction is shown below to illustrate the rhetorical moves that follow introductory sections of these thematic articles (short explanations at the end of each sentence have been added between brackets to summarize what has been stated so far; text from corpus in italics):

> [SITUATION] *The outermost layer of the human eye –the cornea, see Figure 1– is of tremendous importance to good vision* (general background statement in the present tense introducing the topic under concern). *By the early 19th century, physicians recognized the cornea's role in the refraction processes* (specific statement in

the past tense about previous studies). *In the present day, several types of refractive surgery –such as corneal transplants and laser adjustment of the cornea– have become well established as techniques for improving a patient's sight* (specific statement using present perfect tense to compare current research and previous views).

[PROBLEM] *To support these types of surgery, it is essential to have accurate techniques for measuring corneal shape* (statement that categorically justifies the need of further research). *However, the systems available for this task have some serious shortcomings* (statement that explicitly indicates a problem or deficiency).

[SOLUTION-EVALUATION] *This article describes how we can use adaptive surface measurement and parallel cluster computing to improve corneal measurement instruments* (statement of the purpose and scope of the paper, suggesting evidence of the need for the improved proposals presented in the paper).

It would also be interesting to point out how this encapsulated problem-solution pattern is parallel to the moves Swales (1990) proposes for writing introductory sections in research articles following the classical IMRD structure –Introduction-Methods-Results-Discussion (Huckin & Olsen, 1983). In Swales' (1990) CARS model ('Create A Research Space'), the first move is called "establishing a research territory", and involves showing that the general research is important, central or interesting. The second move consists in "establishing a niche", that is to say, indicating a gap in previous research, raising a question about it or extending previous knowledge in some way. Finally, the third move –that he calls "occupying the niche"– should outline the purposes or state the nature of the present research. Although *Computing in Science and Engineering* has no specific rules of organization and style for article publication, their introductory sections could somehow adhere to Swales's suggested pattern. In this sense, it would be interesting to carry out further studies comparing research and thematic articles from the perspective of discourse pragmatics. In any case, both alternative frameworks for content organization may be regarded as rhetorical devices for the sake of relevance in communication, as they facilitate the processing of information on the part of the audience, thereby bridging the gap between pragmatics and cognition.

Rhetorical Signposting: The Role of Discourse Markers

As in any other kind of interaction, the presentation of engineering research is sustained upon two pragmatic parameters: the communicative purpose and the

specialised readership. As far as the former is concerned, technical literature covers multivarious functions; as the selected corpus explicitly states, it "presents", "describes", "develops", "proposes", "formulates", "applies" or "argues". The adequacy of contents and of style depends on the second pragmatic parameter, the intended audience. Only essential information should be transmitted to the peer-experts as both writer(s) and reader(s) share some common conceptual knowledge. Likewise, style should adapt to the genre conventions of this kind of article in order to follow the well-known Gricean cooperative principle (Grice, 1975: 45-47) with its four maxims of quality, quantity, manner and relevance. In the light of pragmatics and cognition, cohesive markers therefore play a vital role to achieve a conscious progressive linkage of the different moves of the problem-solution structure; more particularly, they usually indicate the transition from the problem to the suggested solution. Remarkably, in nine of the articles discourse connectors such as "however", "although", "but", and "therefore" signpost the presentation of a problem, a lack or a gap that must be solved. For similar purposes, lexical evaluation provides readers with obvious textual clues to distinguish between problems and solutions. Lexical references to problems obviously involve negative connotations, as the following selected examples show (own emphasis added):

> ... *to solve difficult computational problems* continue to emerge ... several fundamental questions arise (Mishra, 2002: 42)

> *Unfortunately, peak assignment, one of the process's most time-consuming steps can take weeks.* (Xu et al., 2002: 50)

> *However,* once the notebook fills up with myriad parameters and simulation runs, *it's difficult to grasp* the whole picture. *To overcome this difficulty,* we developed a simulation environment that ... (Hämäläinen & Hirvi, 2002: 64)

> *However,* the systems available for this task have some *serious shortcomings.* (Vos, 2002: 66)

By contrast, the solutions that the authors suggest appear to be positively evaluated for the sake of persuading the audience of the validity of the writers' proposals. As a result, certain recurrent lexicogrammatical features subtly draw readers' expectations towards accepting the authors' claims as essential or pertinent to current research in their corresponding specialised fields. The two examples below illustrate this point (emphasis added):

> This article outlines the *recent development* –both theoretical and experimental– of self-assembled DNA structures, which is *the most advanced and versatile system known* for programmable construction of nanoscale (Reif, 2002: 32)

> *Therefore,* it is *important to develop* a ceramic coating to act as a thermal barrier that increases the operational lifetime of jet engines and *permits higher* operating temperatures, *thereby increasing* thrust and fuel *efficiency.* (Jarvis & Carter, 2002: 33)

According to the theory of relevance in communication (Wilson & Sperber, 1998), the corpus also shows that writers always consider their readers in advance, their previous conceptual background with regard to the subject to be dealt with, and therefore should be concerned with facilitating the audience's inferences and presuppositions for the correct interpretation of the text. In fact, one of the most recognized book for writing among scientists and engineers and students, Robert Barras's *Scientists Must Write* (1978: 80-95), devotes its eighth chapter to "helping the reader", and gives some useful pragmatic hints to specialised writers: to match vocabulary and style to the needs of the audience, to relate new findings to the audience's existing knowledge and interests, to make implications clear by means of a logical sequencing of concepts, to present information at a proper pace, or to provide sufficient evidence of facts, among other suggestions.

Epistemic Modality or Writer's Stance

As illustrated below, introductory sections of thematic articles contain recurrent discourse conventions concerning writers' intrusion in the text. First of all, the ten articles clearly state both their communicative purpose as well as their modality of discourse, either descriptive, narrative or argumentative (emphasis added): "... we advocate ..." (Alur et al., 2002: 20), "This article outlines ..." (Reif, 2002: 32), "I argue that ..." (Mishra, 2002: 42), "In this article we present ..." (Xu et al., 2002: 50), "... we developed ... then applied ..." (Hämäläinen et al., 2002: 64), are some instances of the January-February 2002 issue of the publication, and very similar to those that may be found in the March-April one.

Another common feature of the corpus is that all the articles use the first person singular or plural pronouns –either being one single author or a group of authors–,

which rhetorically conveys a strong sense of commitment of the researchers towards their piece of research. In other words, language becomes more direct and, by using these pronouns, the reader may find overt statements to researchers' undertakings. Sentences like "we must develop a new set of theories" (Alur et al., 2002: 20), "I argue that ..." (Mishra, 2002: 42), "accordingly, we explore ..." (Jarvis & Carter, 2002: 33), or "we need to understand ..." (Peterkin & Luginsland, 2002: 42), among others, convey a more personal commitment on the part of the writers than if they were written –more objectively– in the passive voice.

However, it is worth pointing out that the use of ergative verbs and personifications is the preferred textual formula to foreground the importance of the piece of research rather than the person involved in it. Instead of finding references such as "we indicate in our results that ...", "in this article we focus on ...", or "we describe here ...", we rather find statements like "experimental results indicate ..." (Reif, 2002: 32), "this article focuses on ...", or "the description here uses ..." (Mishra, 2002: 42), just to quote a few examples. As theoretical studies remark (Alcaraz, 2000), the use of ergative verbs may further be considered as a pragmatic feature which conveys some sort of respect and deference towards a broader context of social interaction: the institutional matrix. It then appears that writers avoid referring to themselves and rather foreground the relevance of their proposals for the benefit of technological development.

As far as the sociopragmatic analysis of the corpus is concerned, writers also make use of several rhetorical functions and techniques –as specified by Trimble's classical descriptive work *English for Science and Technology. A Discourse Approach* (1985)– to explain their proposals and develop them coherenty. Some of these are technical definitions, physical, functional or process descriptions, comparisons and contrasts, exemplifications, paraphrases, visual aids, etc. By way of illustration, the following extract from Jarvis and Carter (2002: 33) describes the authors' proposal by specifying the functional and physical features of their research and synthesising these ideas in a visual (our own emphasis added), most probably, with the purpose of clarifying and facilitating the readers' information processing. By this means, technical specifications are systematically provided with great detail and accuracy:

> The TBC of choice, a thin yttria-stabilized-zirconia (YSZ) coating, *reduces* the temperature to which the underlying superalloy is exposed by hundreds of degrees Celsius. A TBC *consists of* three primary layers that cover the macroscopic engine superalloy: the YSZ thermal protective layer, the thermally

grown oxide (TGO) *formed* through bond coat oxidation, and the metal alloy bond coat *composed of* Ni(Co)CrA1Y. *Figure 1 shows a schematic representation* of a TBC's cross section.

Rhetoric, Persuasion and Argumentation

As pointed out before, context becomes a fundamental category of pragmatics which helps us distinguish between the semantic and the pragmatic meaning, the latter born out of the social use of the language (Mey, 1993: 181-191). As with any other variety of language, technical writing is ruled by certain institutional considerations which go beyond mere linguistic parameters. In fact, the academic institution appears to work as a highly restrictive social cluster, and to exert its own "order of discourse" (Foucault, 1970) –the latter understood as a set of social rules of behaviour which directly affect the linguistic choices of the text. In other words, technical writing can be regarded as an instance of "language as a social practice determined by social structures" (Fairclough, 1989: 17). And it is precisely within contemporary science that a perfect model to illustrate this point could be found: the cold fusion controversy (Pinch, 1998).

In 1989, two electrochemists from the University of Utah, Pons and Fleischmann, announced that they had discovered cold fusion. Their experiment was published in two prestigious publications: *The Journal of Electroanalytical Chemistry and Interfacial Electrochemistry,* and in *Nature*. Once the technical details of the discovery were available and the mass media provided constant updates of their progress, replication started and positive results were found all over the world. But suddenly doubts appeared: two prestigious scientific institutions in the U.S. coincided in saying that, after repeating the experiment, the measurements turned out to be incorrect. The paper was mysteriously withdrawn from *Nature* and the two Utah chemists were accused of incompetence and fraud. As Pinch (1998) explains in his article, the sociology of disciplinary knowledge is concerned with the analysis of controversies in the light of a social theory of interpretation. This author claims that, as an institutional entity, the academic community imposes certain conditions on any contribution to the scientific knowledge: it only accepts an experiment if it can be repeated with success, if there exists a relationship between theory and practice, and if the scientists involved have prestige and therefore credibility. Conversely, impropriety, failure in the observation and experimentation of the scientific method, or the intrusion of the mass media in strictly scientific concerns are not accepted by the academic institution (Pinch, 1998: 76).

Whether the cold fusion experiment was credible or not, one of the reasons for the controversy was that Pons and Fleischmann were not well-known figures in the field of nuclear fusion physics, since they belonged to a different group of researchers; they were electrochemists. Was it then a confrontation between two elitist speech communities? Was it a political and economic conspiracy to hide all the advantages that cold fusion could bring to the world? Were there ideological and institutional constraints behind the struggle for research credibility?

In the light of social pragmatics, technical writing seems to be closely related to a complex web of social, institutional and ideological ties. The status of the researchers, the need to publish, to raise funds or to be sponsored, the provisionality of the theories or the respect for authority are, among others, important social conditions that may explain one of the most interesting features of academic discourse: pragmatic politeness (Lakoff, 1973; Brown & Levinson, 1987; Myers, 1989). Together with the objectivity and conceptual accuracy that rhetorical handbooks for scientists and engineers claim, a very subtle use of the language is practised in technical discourse, as will be shown in the conclusion sections of the selected corpus. Once again, it appears that disciplinary texts are not simply the series of imposing statements of facts that it first seems, but rather a rhetorical exercise based on a persuasive and tentative presentation of facts.

Such presentation of facts is grounded on the provisionality of disciplinary research and, ultimately, on the acceptability of the theories by peer-experts. Success in publication largely depends on how well writers state the relevance of their studies and on how well they convince the audience of the validity of the research. In this respect, Harré (1990: 82) defines the research community as a kind of social-moral order "whose internal structure is based upon a network of trust and faith".

Accordingly, technical communication does not only involve transcribing data in a clear and objective way but also convincing the audience of the validity of certain claims and proposals. For example, the use of expressions of finality, as well as cause-effect and reason-result relationships appear to become recurrent rhetorical features in thematic articles for the purpose of persuading the readership of the relevance of the study or the approach suggested in the article. From a pragmatic perspective, these grammatical structures serve writers to justify their experimental procedures, to provide sound explanations to their claims, and to confer evidence to their approaches. These techniques can be understood as a subtle rhetorical attempt to

validate the relevance and the scope of their research and, in a sense, avoid possible refutations or counterargumentations. Some examples from the corpus are provided below (emphasis has been added):

> *To understand* how a network of biochemical reactions implements and controls cellular functions and the genetic regulatory apparatus, *we must develop* a new set of theories [...] We advocate [...] (Alur et al., 2002: 20)

> *To support* these types of surgery, it is essential to have accurate techniques for measuring corneal shape. [...] *This article describes* how we can use adaptive surface measurement and parallel cluster computing to improve corneal measurement instruments. (Vos, 2002: 66)

> Cooling *results in* a rather minimal gain in allowable combustion gas inlet temperature; [...] *Therefore*, it is important to develop a ceramic coating that [...] and *permits* higher operating temperatures, *thereby increasing* thrust and fuel efficiency. (Jarvis & Carter, 2002: 33)

All these discourse features exemplified above intend to foreground the objectivity and reliability upon which the scientific observation of facts should be based. However, the rhetorical moves of introductory sections referred to before also help persuade readers of the relevance of the author's research. We can thus conclude that these pragmatic features of introductory sections in these thematic articles could reify the way language relies heavily on the premises of social interaction "in order to keep functioning as a meaningful social emblem" –to borrow Chambers's (1995: 147) words.

In addition, there seems to be a strong parallelism between the rhetoric of introduction sections of the selected articles and that of their corresponding conclusion sections. In a sense, those recurrent discursive patterns used in the conclusions of the articles may also be deconstructed –intertextually echoing Derrida (1976)–, if they are analysed in the light of social pragmatics. As the corpus will exemplify, technical literature proves to be a live example of the complex but intricate relationship between social institutions and the production of discourse.

Pragmatic Politeness and Hedging in Conclusion Sections

As also happened in the introductory sections of the selected corpus, certain rhetorical techniques are used in the conclusions for different social and pragmatic reasons. The most obvious one is to use grammar and lexis to persuade the audience of the validity of the study, theory or technological application under concern. The following extract, for instance, provides evidence by using a reason-result statement. The last few words of the article textually indicate a sustained argumentation that insists on the validity of the research:

> *Because* it is designed for problems where only limited NMR peaks are available and the peaks could be noisy, *we expect that it will make a useful tool* for NMR structure determination for large proteins (Xu et al., 2002: 61, emphasis added)

Studies on pragmatic politeness (Lakoff 1973, Brown & Levinson 1987, Myers 1989) can also explain why in the conclusion sections of the corpus writers become categorical in asserting the need for future research. It is worth pointing out how lexical and grammatical choices help the writer to imply this meaning:

> ... it is *apparent* that *rigorous* mathematical study of simulation models is worth the effort. Partitioning the parameter space *is a good starting point*, and *no doubt* other *useful* tools exist and can be developed. (Hämäläinen & Hirvi, 2002: 71; emphasis added)

Politeness towards other sub-communities of researchers also determines some textual references concerning the need for interdisciplinary research among different areas of study. "Efforts such as ours can only succeed if they are closely tied to research in experimental biology", state Alur et al. (2002: 29); similarly, Reif (2002: 41) openly remarks that "doing so will require a collaborative interdisciplinary research approach that spans many disciplines".

The pragmatics of discourse makes necessary the authors' acceptance of limitations, thus showing humility, sincerity in the piece of writing. As a result, the underlying semantics of some statements like "we'd like to generalize these concepts to a higher dimensional implementation space. We might also further study shielding effectiveness..." (Hämäläinen & Hirvi, 2002: 71) is very similar, for example, to "we are hurrying to mature the dispersion monograph technology into a suitable tool for

a wide range of operational CB applications" (Boris, 2002: 31). This feature displays the writer's concern about possible counterargumentations and refutations on the part of the specialist peers who act as readership. Some other examples are also found in the corpus (emphasis added):

> We have developed a computational framework for automating the process of resonance peak assignments. *Although* its development is *still* in its early stages, our tests show highly encouraging results. (Xu et al., 2002: 60)

> There *remain many open research issues* that we are *currently pursuing*. [...]. *However*, there may be *critical barriers* that we *must overcome*. (Reif, 2002: 40)

Another pragmatic reason entailed at a discourse level is that of showing respect for the role of the research community in contemporary society, with taxonomic statements like "today, large-scale simulations are *critical* to concept evolution *as well as the research and development* of emerging lethality and survivability technologies" (Schraml et al., 2002: 20). At other times, writers seem to prefer the use of modal verbs to hedge the discourse, and to accept implicitly that the scope of the research is provisional and temporary. "As a direct result of this research we *might* be one step closer to more capable aircraft and more fuel-efficient power plants", conclude Jarvis and Carter (2002: 41). Similarly, Reif finishes his article by putting forward the unstoppable advance of science; in a rather philosophical undertone, he concludes by saying that "we expect that in the next decade, *researchers will succeed* in attaching various classes of molecules to DNA arrays, and a significant portion of the application work I discussed above *will come to pass*" (Reif, 2000: 41).

Together with the use of a persuasive style, technical discourse also complies with the pragmatic criterion of appropriateness, in the sense of the adaptability –or rather, formality– of style to the audience addressed. One of the most systematic features for showing politeness in academic writing are the well-known "hedges" or "hedging devices" (Kress & Hodge, 1979; Salager-Meyer, 1994). In the corpus analysed, expressions of probability –"probably", "possible", "perhaps", "are likely to"–, modal verbs –"could", "may", "might"–, epistemic verbs –"suggest", "believe", "hope"– and non-specifying adverbs –"roughly", "somewhat"– are useful pragmatic tools which allow writers not to be categorical, but rather tentative and cautious in the presentation of their claims.

These rhetorical features, among others, contribute to pragmatic politeness, considering that research claims are only accepted if writers persuasively convince the community through the exchange of argumentations and counter-argumentations. Stylistic devices of this kind may also work to foreground the respect of the writer for the epistemic community, regarded both as an elitist membership and as the "keeper" or "guardian" of academic reasoning itself.

Conclusions

As evidenced in the corpus, introductory sections of thematic articles appear to contain a consistent use of rhetorical structures, moves, and discourse signposting for facilitating information processing and thus favouring relevance in communication. In addition, the analysis of conclusion sections proves to be more ideologically constrained with regard to the institutional community and the sociology of disciplinary knowledge, as shown in the recurrent use of persuasion, hedging, cause-effect argumentation, and the writer's interpersonal intrusion in the text. According to the corpus analysed, there also appears to be a subtle rhetorical move from the importance of personal authority found in introductory sections to the relevance of intellectual authority –or "order of discourse"– in conclusion sections. In other words, the sociocultural context of technical communication can better explain why the hermeneutics of disciplinary reasoning and, more specifically, the discourse practices of the community are sociologically and ideologically determined. In an attempt to relate language, cognition and culture, Langacker (1999: 248) foregrounds the contextual basis of cognition by stating that "the processing constitutive of language has to be studied and described with reference to the social and contextual interaction of actual language use."

This paper has attempted to map out how social and contextual factors seem to exert an enormous influence on both textual and discourse layers of technical communication. Analyses of this type can provide evidence of how those sociological bounds entailed in technical communication can deepen our cognisance of the institutional matrix as both a ruler and practitioner of this particular variety of language. It would be interesting to find further research concerning the rhetorical articulation of this particular sub-genre and other technical genres both from theoretical and applied perspectives. Further studies on the use of rhetoric in thematic

articles should also be approached in the light of disciplinary variation among scientific and technical disciplines. Also, efforts should be made to bridge the gap between genre studies and their pedagogical implications for ESP teaching; as Bhatia (2002: 3) remarks, genre analysis "may be seen as a reflection of the complex realities of the world of institutionalised communication, or it may be seen as a pedagogically effective and convenient tool for the design of language teaching programmes."

1 For further studies on thematic articles, see Posteguillo's (1999) analysis of the linguistic and pragmatic differences between thematic and research articles in computing.

REFERENCES

Alcaraz, E. (2000). *El inglés profesional y académico*. Madrid: Alianza Editorial.

Barras, R. (1978). *Scientists Must Write. A Guide to Better Writing for Scientists, Engineers and Students*. London & New York: Chapman & Hall.

Bathia, V. K. (1993). *Analysing Genre: Language Use in Professional Settings*. London & New York: Longman.

Bhatia, V. K. (2002). "Applied Genre Analysis: a Multi-Perspective Model" *Ibérica* 4: 3-19.

Biber, D. & E. Finegan (eds.) (1994). *Sociolinguistic Perspectives on Register*. New York, Oxford: Oxford University Press.

Brown, P. & S. Levinson (1987). *Politeness: Some Universals in Language Use*. Cambridge: Cambridge University Press.

Chambers, J. K. (1995). *Sociolinguistic Theory. Linguistic Variation and its Social Significance*. Oxford: Blackwell Publishers.

Day, R. A. (1979). *How to Write and Publish a Scientific Paper*. Philadelphia: Orix Press.

Derrida, J. (1976). "...That Dangerous Supplement...", in G. C. Spivak (ed.). *Of Grammatology*. Baltimore, Md.: Johns Hopkins University Press.

Eisenberg, A. (1993). *Effective Technical Communication*. Singapore: McGraw-Hill International Editions.

Fairclough, N. (1989). *Language and Power*. London & New York: Longman.

Flowerdew, J. (ed.) (2002). *Academic Discourse*. Harlow: Pearson Education Limited.

Foucault, M. (1970). *The Order of Things: An Archeology of the Human Sciences*. New York: Randon House.

Grice, H. P. (1975). "Logic and Conversation" in P. Cole & J. L. Morgan (eds.) *Syntax and Semantics* 3, 44-58. New York: Academic Press.

Kress, G. & R. Hodge (1979). *Language as Ideology*. London: Routledge & Kegan Paul.

Hamp-Lyons, L. & B. Heasley (1987). *Study Writing. A Course in Written English for Academic and Professional Purposes*. Cambridge: Cambridge University Press.

Harré, R. 1990. "Some Narrative Conventions of Scientific Discourse" in C. Nash (ed.) *Narrative in Culture*, 81-101. London, New York: Routledge.

Hoey, M. (1985). *On the Surface of Discourse*. London: Allen & Unwin.

Huckin, T. N. & L. A. Olsen (1983). *English for Science and Technology. A Handbook for Nonnative Speakers*. New York: McGraw-Hill Book Company.

Hyland, K. (2000). *Disciplinary Discourses. Social Interactions in Academic Writing*. Harlow: Pearson Education Limited.

Lakoff, R. (1973). "The Logic of Politeness: or Minding your p's and q's". *Papers from the Regional Meeting* IX, 292-305. Chicago: Chicago Linguistic Society.

Langacker, R. W. (1999). "The Contextual Basis of Cognitive Semantics" in J. Nuyts & E. Pederson (eds.), *Language and Conceptualization*, 229-252. Cambridge: Cambridge University Press.

Mey, J. L. (1993). *Pragmatics. An Introduction*. Oxford: Blackwell.

Myers, G. (1989). "The Pragmatics of Politeness in Scientific Articles." *Applied Linguistics* 10, 1: 1-35.

Pinch, T. (1998). "Cold Fusion and the Sociology of Scientific Knowledge" in J. Battalio (ed.), *Essays in the Study of Scientific Discourse. Methods, Practice, and Pedagogy*, 73-87. Stamford, CT: Ablex Publishing Corporation.

Posteguillo, S. (1999). "The Schematic Structure of Computer Science Research Articles." *English for Specific Purposes* 18,2: 139-160.

Rollinson, P. (1996). *An Introduction to Academic Writing*. Madrid: Ediciones de la Universidad Autónoma de Madrid.

Salager-Meyer, F. (1994). "Hedges and Textual Communicative Function in Medical English Written Discourse." *English for Specific Purposes* 13,2: 149-70.

Scollon, R. & S. W. Scollon (1995). *Intercultural Communication: A Discourse Approach*. Oxford: Blackwell.

Swales, J. M. (1990). *Genre Analysis. English in Academic and Research Settings*. Cambridge: Cambridge University Press.

Tannen, D. & C. Wallat (1999). "Interactive Frames and Knowledge Schemas in Interaction: Examples from a Medical Examination/Interview" in A. Javorsky & N. Coupland (eds.), *The Discourse Reader*, 346-376. London: Routledge.

Trimble, L. T. (1985). *English for Science and Technology. A Discourse Approach*. Cambridge: Cambridge University Press.

Weissberg, R. & S. Buker (1990), *Writing Up Research. Experimental Research Report Writing for Students of English*. New Jersey: Prentice Hall.

Wilkinson, A. (1991). *The Scientist´s Handbook for Writing Papers and Dissertations*. New Jersey: Prentice Hall.

Wilson, D. & D. Sperber (1998). "Pragmatics and Time" in R. Carston & S. Uchida (eds.) *Relevance Theory. Applications and Implications*, 1-22. Amsterdam, Philadelphia: John Benjamins.

Yule, G. (1996). *Pragmatics*. Oxford: Oxford University Press.

APPENDIX

Alur, R., C. Belta, V. Kumar, M. Mintz, G. Pappas, H. Rubin & J. Schug (2002). "Modeling and Analyzing Biomolecular Networks". *Computing in Science and Engineering* 4,1: 20-29.

Boris, J. (2002). "The Threat of Chemical and Biological Terrorism: Preparing a Response". *Computing in Science and Engineering* 4,2: 22-31.

Hämäläinen, J. & K. Hirvi (2002). "Using Mathematical Models to Cope with Complex Computer Simulations". *Computing in Science and Engineering* 4,1: 64-71.

Jarvis, E.A. & E.A. Carter (2002). "The Role of Reactive Elements in Thermal Barrier Coatings". *Computing in Science and Engineering* 4,2: 33-41.

Mishra, B. (2002). "Comparing Genomes". *Computing in Science and Engineering* 4,1: 42-49.

Peterkin, R. & J.W. Luginsland (2002). "A Virtual Prototyping Environment for Directed-Energy Concepts". *Computing in Science and Engineering* 4,2: 42-48.

Reif, J.H. (2002). "DNA Lattices: A Method for Molecular-Scale Patterning and Computation" *Computing in Science and Engineering* 4,1: 32-41.

Schraml, S., K.D. Kimsey & J.A. Clarke (2002). "High-Performance Computing Applications for Survivability-Lethality Technologies". *Computing in Science and Engineering* 4,2: 16-21.

Vos, F.M. (2002). "Real-Time, Adaptive Measurement of Corneal Shapes". *Computing in Science and Engineering* 4,2: 66-75.

Xu, Y., D. Xu, D. Kim, V. Olman & J. Razumovskaya (2002). "Automated Assignment of Backbone NMR Peaks Using Constrained Bipartite Matching". *Computing in Science and Engineering* 4,1: 50-61.