Carmen Pérez-Llantada

Scientific Discourse and the Rhetoric of Globalization

The Impact of Culture and Language

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The Impact of Culture and Language

Carmen Pérez-Llantada

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In memoriam

To those who believed that science and religion are not in contradiction and that both are fundamental to life's understanding.

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Zaragoza, 12 October 2011.

Chapter 1

The Role of Science Rhetoric in the Global Village

Setting the Scene

Nobody would deny that within the scientific and research arena globalization is a term which has become fashionable in the past decades. Changes in the contemporary scene move at an unprecedented pace, hence new questions, interests and dilemmas invite scientists today to establish new forms of dialogue and information exchange. This volume introduces readers to a specific approach to language, culture, science and globalization centred around the notion of discourse and strongly influenced by the socio-cultural views of James P. Gee's (1996) on the ideological construction of discourses. But, how is the experience of living in a globalizing world affecting contemporary scholarly life? What is the scope of the changes produced by globalization in academic and research settings and can changes have motives? To what extent do knowledge-based economies determine research activities and assess research output? How are individual scholars and their research practices affected by these global changes across cultural contexts? How is scientific knowledge[1] disseminated by the current discourse practices of the scholars today? And, most importantly, what role does the English language play amidst the complex contemporary landscape? This volume poses these and other questions for a gained understanding of the interrelatedness between science, language(s), culture(s) and the processes of globalization at the turn of the first decade of the twenty-first century.

1. Throughout the book the term 'scientific knowledge' will be used in its broad sense so that it covers scientific research production in the four macro-areas of investigation, both hard pure and hard applied sciences, soft pure and soft applied sciences (Becher and Trowler 2001): biological and health sciences, social sciences and education, physical sciences and engineering, humanities and arts. From their distinct disciplinary domains and research territories, these four macro-areas contribute on equal terms to contemporary scientific advancement.

History faithfully tells that the post-Cold War era brought about greatest impact on foreign policy and international affairs,

> the spatial reorganization of production, the interpenetration of industries across borders, the spread of financial markets, the diffusion of identical consumer goods to distant countries, massive transfers of populations within the South and the East to the West, resultant conflicts between immigrant and established communities in formerly tight-knit neighborhood, and an emerging world-wide preference for democracy. (Mittelman 1996, p. 2)

The emerging global economy and the streamlining of international trade are often associated with accountability and sustainable development but also with increased multiculturalism heralding changes in social relations and cultural models, values and attitudes. As Mittelman (1996, p. 3) puts it, 'globalization is a coalescence of varied transnational processes and domestic structures, allowing the economy, politics, culture and ideology of one country to penetrate another'. Along similar lines, in his seminal work *The Consequences of Modernity* sociologist Anthony Giddens (1990, p. 64) judiciously defines 'globalization' as the 'intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa'. As one of the fundamental consequences of modernity, globalization is inescapably influencing the activities taking place in the academic and research domains. As discussed later in this volume, the drive of knowledge-intensive economies fuelled by reasons of competition and prestige has stimulated fruitful modes of connection between different local contexts and developed networks for cooperation and research exchange. While coexisting with minor and local languages, English has become, at least to date, the main lingua franca for research networking and scientific communication across different cultural contexts and different languages. English Lingua Franca (ELF heretofore) facilitates the interconnection between individuals and large-scale systems, and between local and global settings of knowledge production.

This intertwining socio-cultural panorama makes it necessary to address the impact of language and culture on contemporary scientific discourse. According to the Common European Framework of Reference for Languages (Council of Europe 2001), plurilingualism refers to the repertoire of languages which many individuals use in their personal and/or professional life. In academia, the concept of 'plurilingual' scholar refers to those whose native language or national official language is not English but who use English as an additional language for professional purposes. This volume contests the monolithic assumptions of Anglophone rhetoric of science and draws on the reported practices of academic communities across languages and cultures as varied as German, Finnish, French, Norwegian, Russian, Bulgarian, Ukrainian, Russian, Italian or Polish, to name a few (see, e.g., Ammon 1990, Cooke 1993,

Mauranen 1993a, b, Vassileva 2000, Blagojevic 2004, Dahl 2004, Yakhontova 2006, Duszak and Lewkowicz 2008, Lillis and Curry 2010, among others) to examine scholarly textual output produced by both native-English and non-native English academics, and enquire into the established research processes and particular procedures of interaction within sub-disciplinary scientific communities in Anglophone and non-Anglophone sites of interaction. Taking the Spanish scholarly community as an instance of a relatively under-researched group of plurilingual academics – except for St John 1987, Curry and Lillis 2004, Fernández-Polo and Cal-Varela 2009, Ferguson et al. 2011, Pérez-Llantada et al. 2011 – the volume discusses the linguistic burden that using English as an L2 for scientific communication represents to non-native English-speaking scholars. In doing so, the volume raises a number of yet unsolved issues related to the evolving 'generic integrity' of contemporary written/spoken scientific discourse, understanding 'generic integrity' as the 'socio-cognitive and cultural factors that have a significant bearing on the way genres are constructed and interpreted in professional contexts' (Bhatia 2004, p. 112). One of the issues is the growing internationalization of research activities and the marketized – for some, 'commodifying' – nature of scientific knowledge and research output. At present, this is a major issue considering that the number of research articles published by a higher education or a research institution is one of the indicators of quality assurance and institutional prestige. The second issue is related to the linguistic and discoursal changes in the English language itself and, more specifically, the nativization vs hybridization of L2 English scientific discourse (cf. House 2003, Nickerson 2005, Mauranen et al. 2010a). Other issues such as scholars' practices, their perceptions and attitudes towards the advantages and disadvantages of using English as the international language for communication or questions relating to English gradually displacing other minority or local languages in academic and research contexts are also of relevance for a better understanding of the rhetoric of globalization in the contemporary scene. Last but not least, assessing these issues above deems it necessary to discuss English for Academic Purposes (EAP heretofore) pedagogy in relation to the benchmarking of educational policies and the delimitation of geopolitical spaces in Europe and elsewhere.

On the question of how scientists should write, Barras (1978, pp. 28–36) emphasizes the importance of an explanatory and methodical narrative account of facts, complemented with the following conceptual and stylistic qualities: objectivity, impartiality supported by evidence, accuracy of details and propriety of research reporting, as well as order in the exposition of facts and clarity of expression. Barras also stresses the importance of capturing the readers' interest and facilitating their understanding of the text. Already three decades ago, he further noted that science publishing may involve 'readers who do not speak English as their mother tongue', and hence provides observations on the importance of using good English for effective and efficient dissemination of scientific knowledge. Some of the good practices that he

proposes include conferring importance to grammar aspects, making meanings sufficiently clear and making language appropriate to the context (1978, pp. 88–9). These good practices cover what Bhatia (2004, p. 123) calls 'text-internal' aspects (i.e. lexicogrammar, discourse and rhetorical organization) and 'text-external' aspects of texts (i.e. the procedures and practices for the construction and interpretation of the texts by the community members). Both aspects are examined throughout this volume.

There is at present some discrepancy as to what makes good research writing. Barras's conceptions above are applicable to effective academic writing but nonetheless require a re-conceptualization in the light of the important changes and transformations that globalization has brought about in academia. The dominance of English in global scientific communication recalls Pennycook's (2007, p. 49) words on sociolinguistic changes and globalization:

> [. . .] it can be useful to draw a distinction between postmodernity and postmodernism, the first focusing on real changes to language and culture in a new era of global communication, the second on the ways in which language and culture have been constructed through the discourses of modernity.

Of course, propriety of research reporting and clarity of expression do not guarantee success in publication. Swales (2004, p. 56) refers to genre familiarity and experience in publishing in order to reduce the distinction between native and non-native speakers of English in today's research world. Scholarly literature abounds in reports of native, but above all, non-native scholars' difficulties in using English lexicogrammar and discourse conventions appropriately, as well as in organizing information, highlighting important findings, expressing an authorial voice or successfully convincing the audience of the validity of the claims made in research writing/speaking. In contradicting these claims about the disadvantages that non-native English scholars face when communicating academically, Belcher argues that good quality in science, and not the use of English, is what really matters if one is seeking eventual publication.

The increased emphasis on English for intercultural communication also makes it necessary to revise the main economic and geopolitical reasons that have contributed to its hegemonic status. The historical legacy of the British Empire together with the predominance of the United States in commercial, economic and political spheres in the last century gradually triggered the increasing use of English as the main means of communication on a worldwide scale (Crystal 1997, Ferguson 2005, 2007). The incessant advance of the new technologies also enables an immense and extremely rapid transfer of knowledge. Today the number of internet users has reached 2,000 million, of which 485 million are from China, 272 million from the United States and 99 million from Japan. European internet users reached the impressive figure

of 476, 213, 935 users in 2011 (from <http://www.internetworldstats.com/stats.htm>, 30 December 2011), with the United Kingdom, Germany, France, Russia, Spain and Turkey appearing at the top of the table. Academia does not escape from these ruling communication trends.

It is a fact that research output does truly count in every academic career and, broadly speaking, in the current globalizing context of highly competitive knowledge-intensive economies. Scholarly performance thus raises a number of concerns. One of them is the fact that published peer-reviewed research articles are considered to be one of the indicators that explicitly measure the national research workforce and performance. As a result, the emergence of academic rankings has attracted observations on scholarly production. Some have regarded this situation as critical in the sense that the rate of production may be diminishing the quality of science. These observations are partially convincing, though, in so much as they faithfully depict the pressure on scholars to publish in order to climb the academic ladder:

> Measurement of scientific productivity is difficult. The measures used are crude. But these measures are now so universally adopted that they determine most things that matter [to scholars]: tenure or unemployment, a postdoctoral grant or none, success or failure. As a result, scientists have been forced to downgrade their primary aim for making discoveries to publishing as many papers as possible – and trying to work them into high impact-factor journals. Consequently, scientific behavior has become distorted and the utility, quality, and objectivity of articles have deteriorated. (Lawrence 2008, p. 1)

The complexities of globalization and its expanding networking processes likewise impact on contemporary scientific discourse practices and procedures. This impact is felt fairly equally, as this volume contends, by native and non-native English scholars. For this reason, we need detailed records of everyday academic and research genre-based practices of the local academic communities that use English as an additional language for scientific communication. After all, these practices and procedures are actually the origin of research output.

Theoretical and Methodological Orientations

Theoretically, this volume takes a decidedly rhetorical and genre-oriented slant, heavily inspired by Carolyn Miller's (1984) article, 'Genre as social action' and Swales's seminal works *Genre Analysis* (1990) and *Research Genres* (2004). From this perspective, the volume focuses on the exploration of scientific discourse as a key constituent in the processes of construction, transmission and interpretation of scientific knowledge. Complementing this analytical framework, the volume also

draws initial inspiration from influential postmodernist and post-structuralist theories, as it views scientific knowledge production and its ensuing dissemination through academic writing/speaking as one more manifest cultural activity of the postmodern age. In various different ways, as philosophers of science have argued (Kuhn 1962, Knorr-Cetina 1981, 2009, Latour and Woolgar 1986, Longino 1990), these activities seek to go beyond the systematic description of reality and question objectivist categorical epistemologies. They acknowledge instead the provisionality of truth. It is thus no surprise that in discussing the rhetoric of science Gragson and Gragson (1998, p. 20) conclude that true objectivity is elusive and that 'the confluence of urgency, uncertainty and technology is challenging the tried-and-true at every level in science'.

From these complementary theoretical standpoints, the volume examines scientific discourse in the increasingly globalizing world and seeks to provide a multidimensional view of it across research scenarios in different cultures and languages. It purports to provide a wide-angle view of discoursal and rhetorical practices in Anglophone/non-Anglophone academic contexts at already the beginning of the second decade of the twenty-first century. It specifically looks into the way local academic sites mirror the multicultural richness of human subjects (i.e. researchers), their scientific production and their actual knowledge dissemination practices and procedures. The volume further seeks to describe and illustrate how scientific discourse involves a number of complex linguistic and rhetorical issues that arise in an age of unquestionable cross-cultural communication.

To analyse the impact of language and culture the volume provides evidence of discursive similarities but also discursive hybridization processes in standard academic English norms across different cultural contexts. It does so combining both text-linguistic and ethnographic analyses. The former methodology relies on corpus-based data as the latter allow identification of recurrent lexicogrammar patterns and variation of those patterns in terms of frequency of use and discourse functions. Corpus data also allow recognition of preferred textual development and rhetorical styles for building arguments in different cultural contexts. More specifically, the volume looks into how both native and non-native English-speaking scholars construct disciplinary knowledge, how they project a persona, evaluate new findings, claim centrality, commit to propositions and establish solidarity relationships and/or express respect and politeness towards the wide international audience. Such linguistic enquiry will further help address non-native English scholars' problems in a 'publish in English or perish' world and generate discussion on appropriate ways of providing suitable linguistic guidance to plurilingual scholars and also on the acceptability of borrowing L1 culture-specific discoursal and rhetorical traits in L2 scientific English.

The ethnographic account seeks to provide an examination of the actual practices of the scholars across cultural contexts (an Anglophone vs a

non-Anglophone-based context) and across disciplinary cultures, their generic norms and conventions, their particular epistemologies and the construction of professional identities. Exploring the situational context of scientific discourse will yield evidence of similar procedures within the internationalization process taking place at universities: expanding research collaboration, knowledge exchange and networking, all of them playing an increasing role in the day to day work of academics. Such exploration provides further insights into the contexts of written/spoken textual production, hence offering a multidimensional view of scientific discourse across increasingly competitive institutional settings, knowledge-intensive economies as well as critical geopolitical interests that support English as the lingua franca within the global order of academic and research interaction.

Rationale of the Study and Intended Readership

This volume seeks to offer an in-depth examination of today's scientific rhetoric and discursive practices and enquires into the socio-cultural reasons for the adoption and hybridization processes of the standardized scientific discourse norms. In doing so, it seeks to re-define the rhetoric of contemporary science communication.

The volume makes readers aware of the variegated reasoning patterns and rhetorically forceful arguments used in the construction and dissemination of research in light of the socio-rhetorical constraints imposed by the nature of contemporary science on the one hand and by the globalizing socio-cultural and geopolitical trends on the other hand. Essentially, it addresses current scholarly concern on the shifting rhetorical practices of contemporary science dissemination in the increasingly multilingual and multicultural academic and research arena. It contests monolingual assumptions informing scientific discourse, its rhetorical practices and pedagogical approaches and calls attention to the emerging 'glocal' discourses (with unique rhetorical traits) that are hybridizing the Western notions of scientific rhetoric. In acknowledging the hegemonic role of English as the lingua franca in the global village, the book conducts an intercultural rhetoric analysis to compare how scientists in Anglophone and non-Anglophone contexts utilize the standard rhetorical conventions for scientific discourse. In light of culture and language issues, the book examines how scientific texts (genres) bring to the fore the merging of the standard Anglophone rhetorical conventions with the culture-specific rhetorical traditions and intellectual styles of the non-native English scholars.

As explained in the section below, the book also takes an academic literacies approach to provide rhetorically- and pedagogically informed discussion on the 'textographies' – that is, the scientists' ways and modes of interaction within their research sites – and enquires into the processes of disciplinary (academic)

enculturation of scholars in both Anglophone and non-Anglophone-based contexts. The complementary approach to scientific written texts and writing processes/practices in the multicultural academic arena provides evidence of the shifting rhetorical paradigms of contemporary science and of the dynamics of the alternative geolinguistic spaces constituting scientific communication in today's research world. Claiming the growing importance of rhetorical paradigms resulting from the politics of scientific discourse, the book finally re-defines the contemporary rhetoric of science and specifically describes it as a response to global challenges – namely, the exigencies of scientific knowledge production, the exigencies of knowledge-intensive economies and the exigencies of universities and research innovation – and as a response to the new forms of academic interdependence.

The comprehensive analysis of the rhetoric of science in a 'publish in English or perish' milieu makes it easy to envisage a wide, multidisciplinary audience. Essentially, the book targets at scholars in rhetoric and composition, who have recently claimed that communication today involves an engagement with multiple languages and literacies and who are then showing growing interest in how current rhetorical norms need to evolve with the scientific, social and cultural signs of the times. It also addresses scientists themselves, both native and non-native English speakers, who want or need to get their research disseminated worldwide and gain international visibility and recognition for their work. The book will help them understand and utilize rhetorically effective reasoning patterns for engaging in effective intercultural dialogue on science.

A main target audience is that of applied linguists and genre analysts, who will find lively discussion, at various levels of analysis, on convergences and divergences in the rhetoric of science dissemination practices and in the actual texts (genres). Offering an in-depth exploration of the links between genre, culture, language and pedagogy can also provide EAP instructors with useful guidelines for making informed pedagogical decisions on how to approach the learning of second language competence while advocating the rich culture-specific traits that plurilingual scholars bring to rhetoric and communication. Translators of specialized texts across disciplinary domains as well as those professionals involved in language advising/counselling and editing of scientific manuscripts prior to publication will also find illuminating discussion on convergent phraseological preferences in scientific discourse across languages and cultures as well as divergent rhetorical paradigms and intellectual styles in today's cross-cultural scientific communication. Finally, the volume is of interest for those involved in developing adequate and successful linguistic policies that may strengthen and foster the international competitiveness of higher education and institutions worldwide. On socio-political and economic grounds, an understanding of the new rhetorical paradigms of scientific discourse may lead to fruitful rigorous decisions for fuelling knowledge-intensive economies and prestige among higher education institutions.

Structure and Scope of the Volume

In view of the growing importance of English-only research publication outputs as key indicators of excellence in knowledge-intensive, competitive research sites, Chapter 2, 'Scientific English in the Postmodern Age', enquires into the dynamics of scientific discourse and, more specifically into research writing, with the research article unquestionably considered the research genre *par excellence*. It explores the commodifying forces affecting scientific research in academia and analyses the role of English in disseminating new disciplinary findings. The privileged status of the English language in the current academic and research arena does not only contribute to interaction across local and global research communities but also facilitates collaboration for the sake of the advancement of science and the welfare of society. In short, scientific discourse will be regarded as a 'global' discourse in that it allows networking across academic contexts worldwide. Regarded both as a textual process and a textual product, scientific discourse creates expanding sets of worldwide academic exchanges. In describing such global nature, it validates Bakhtin's (1986) view that social interaction is at the centre of language usage. As discussed in this chapter, contemporary scientific discourse is highly dialogic and contextually determined and, as a result, opens up multifarious avenues for linguistic exploration. In terms of linguistic theory, this chapter is principally informed by genre analysis and ESP (Swales 1990, 2004, Hyon 1996) but also benefits considerably from applied discourse analysis (Bhatia 1993, 2004), the North-American New Rhetoric school (Miller 1984, Huckin 1991, Berkenkotter and Huckin 1995), contrastive rhetoric and intercultural communication (Connor 2002, Connor et al. 2008, Candlin and Gotti 2007), social discourse analysis (Gee 1996, 1999) and the ethnography of communication (Geertz 1983, Button 1991, Swales 1998).

Starting from the premise that scientific discourse instantiates a marketized commodity within the new signs of the times in academic and research settings, Chapter 3, 'Problematizing the Rhetoric of Contemporary Science', sets the 'genre' scene. It defines scientific discourse and its socio-rhetorical framing contexts. Scientific discourse is described as a rich rhetorical construct which subtly intertwines information as well as persuasion and promotional elements for the construction, dissemination and eventual acceptance of new knowledge claims by the scientific/disciplinary community.

Scientific discourse has merited considerable attention in the literature, which has analysed its social background (Gilbert and Mulkay 1984, Bazerman 1988, 1994, Candlin and Hyland 1999), communicative purposes (Askehave and Swales 2001), rhetorical organization (Huckin 1991) EAP instructional and pedagogical approaches (Swales and Feak 1996, 2009a,b, Paltridge 2002, Feak 2011), and a comprehensive list of lexicogrammatical and interactional features which will be detailed in the chapter. As described in this chapter, scientific discourse has favoured comparison across written and spoken

academic genres as well as across languages and cultural contexts. Bhatia's (2004, p. 20) succinct revision of the tenets of genre analysis easily applies to contemporary scientific discourse:

> Discourse as genre, in contrast, extends the analysis beyond the textual product to incorporate context in a broader sense to account for not only the way the text is constructed, but also the way it is often interpreted, used and exploited in specific institutional or more narrowly professional contexts to achieve specific disciplinary roles.

Within its institutional context, the discourse of science brings to the fore contemporary disciplinary knowledge production and dissemination practices. Scientific discourse is the process which involves how knowledge becomes text and text begets knowledge. As such, it encompasses different linguistic resources of establishing truth supported by critical reading and validation of hypothesis (Barras 1978, p. 121). It also takes in particular ways of reflecting the degree of authorial commitment to/detachment from the propositional meanings of the texts – labelled in various ways such as stance, evaluation, interpersonal and interactive metadiscourse, among others – and ways of facilitating addressees' comprehension, engaging them and aligning with them along the lines proposed in the text (Hyland 1998a, b, 2000). These features point to the fact that, as a form of language, scientific discourse is 'not only used to convey information, it also presents this information through the organization of the text itself (on the autonomous plane) and engage the readers as to how they should understand it (on the interactive plane)' (Hyland 2005, p. 8).

In addition, Chapter 3 specifically looks into the two major goals of the rhetoric of science in the context of transnational scientific communication: transmitting new knowledge claims and selling these claims to the disciplinary community at large. This chapter seeks to explain further constraints for understanding this two-fold goal, namely the linguistic and interactional features of scientific discourse such as its standardized lexicogrammar, rhetorical organization of information and clines of authorial stance (cf. referentiality, intertextuality, text-reflexivity, discourse organizing devices and various argumentation resources). The chapter also looks into the role of genres in native-English and non-native English communities of practice, and into the particular ethos of each discipline and the cultural values and ideologies of different research communities that underpin scientific discourse as a process and a product. In exploring the textualization, organization and contextualization of the discourse of science, the chapter paves the way towards the investigation of discursive convergences and divergences in L1 and L2 English research reporting.

Chapter 4, 'A Contrastive Rhetoric Approach to Science Dissemination', focuses on research article writing in both Anglophone and non-Anglophone

contexts and places emphasis on 'the local and the contingent' (Sarup 1993, p. 166) – hence echoing the post-structuralist concept of fragmentation as opposed to the concepts of totality and consistency (in the sense of standardization). But rather than division, fragmentation in this chapter is understood here as diversity and variation both at linguistic, discoursal and rhetorical levels. Assuming that cultural features affect language features, this chapter understands scientific discourse as a textual end-product deeply embedded within the social (institutional) as well as in the cultural backgrounds where it is produced and received. In doing so, the chapter raises the issue of homogeneity vs heterogeneity (Englishization vs hybridization) in scientific discourse and provides research-informed discussion on traceable textual similarities and differences in L1 vs L2 English texts.

Bearing in mind that discursive hybridization may well involve the merging of the standardized rhetorical style (i.e. the Anglophone order of discourse) and the local rhetorical styles (i.e. non-Anglophone orders of discourse), this chapter seeks to bring to the surface the extent to which the transfer of L1 traits to the L2 English texts involves a transfer of preferred lexicogrammatical choices as well as a transfer of features belonging to the specific intellectual style ascribed to a given culture. To all intents and purposes, the investigation as revealed in this chapter is primarily corpus based, a trend methodologically useful for enquiring into the actual textual, discoursal and rhetorical production (Sinclair 2004). Corpus data provides interesting comparisons across disciplines and languages, and supplies more accurate descriptions of how scientific discourse varies across different cultural contexts and different languages. Issues of phraseology, rhetorical organization, authorial stance and construction of dialogic spaces in different 'orders of discourse' – the core vs the peripheral – are addressed in this chapter with the aim of understanding how plurilingual scientists construct disciplinary knowledge through established textual practices and through their particular cultural lens. Using textual analysis, a sample of linguistic features (i.e. lexicogrammatical resources, organization of texts/text developments and rhetorical strategies) is analysed to compare how native and non-native English-speaking scientists convey provisionality, highlight their findings, negotiate meanings and convince their readership of the validity of their research. The combined study of lexicogrammar and discourse functions above sentence level lends evidence of the fact that scientific discourse is impacted by language and culture, as reflected in the rich variety of hybrid features that may rightly be called 'academic Englishes' (Mauranen et al. 2010b, p. 634).

Complementing the corpus-based analysis, Chapter 5, 'Disciplinary Practices and Procedures within Research Sites', approaches the contextual aspects of scientific discourse. It examines the actual scholarly practices implicated in reporting science in English. The chapter relies on interview-based data and ethnographic and textographic exploration (Swales 1998). A particular highlight of

this chapter is that it compiles information from both native English scholars (i.e. scholars from a North-American-based context) and non-native English (i.e. scholars from a Spanish context). The aim is to develop a cross-cultural comparison of research procedures of sub-disciplinary communities, along with the research processes through which scientific discourse is gestated and evolves within these communities. The interviews with the scholars include relevant observations on their awareness of the social dynamics involved in the process of publishing transnationally as well as their adherence to rhetorical conventions in the transmission of knowledge. Grounded in the theoretical premises of applied discourse analysis of specialized texts, the ethnographic approach offers an accurate definition of the dynamic nature of research reporting across Anglophone and non-Anglophone academic and research sites. It further provides an understanding of the way disciplinary knowledge is constructed through research processes and community practices and procedures.

Alongside the enquiry into research processes, this chapter also seeks to identify the scholars' attitudes towards the importance of research publication and their views on the role of English in the academic world. In discussing the advantages and disadvantages of using English as a lingua franca for academic communication, the scholars provide highly illuminating data on issues as varied as the existence of discipline-specific rhetorical conventions, the importance of having a research publishing experience, the role of senior scholars in enculturating novice researchers, the importance of plurilingualism and the impact of the spread of English in the 'inner' circle as well as in the 'outer' and 'expanding' circles (Kachru 1981, 1985, 1986). These text-external factors need further discussion in relation to the text-internal factors of scientific discourse illustrated in Chapter 4. With this background, Chapter 5 highlights the institutional forces operating in the research and publishing processes in university settings and the way these forces bring to the fore the sociorhetorical nature of scientific communication, 'centered not on the substance or the form of discourse but on the action it is used to accomplish' (Miller 1984, p. 151). In drawing attention to the interrelationship between texts as products and community practices and procedures, the chapter argues for a multidimensional approach to scientific genres and their social context, the latter shaped in terms of disciplinary practices and disciplinary cultures.

Chapter 6, 'Triangulating Procedures, Practices and Texts in Scientific Discourse', poses a number of unresolved challenges on the relationship between research knowledge production, research knowledge dissemination at universities as well as innovation and development. To address those challenges, this chapter triangulates the findings reported in the previous two chapters with the aim of interpreting scientific genres as multidimensional constructs rooted in discourse practices and community procedures for interaction. Bearing in mind the text-context interrelation, this chapter formulates a number of issues which require careful consideration from linguistic, socio-rhetorical and pedagogical

standpoints. Assuming that the 'research-reporting narratives' of the scholars in Anglophone and non-Anglophone contexts share common discourse practices and procedures but to some extent differ in terms of intellectual styles and rhetorical preferences, how are discursive hybridities explicitly traceable in scientific discourse across languages and across different academic disciplines? Second, if as argued here and in the literature, non-native English scholars find it difficult to handle the language according to Anglophone standards, can discoursal hybridity be interpreted as a sign of weakness eventually leading to lack of clarity and hence lack of acceptance for scientific dissemination transnationally? On a related manner, how is 'hybrid scientific discourse' accepted by science and journal gate-keepers? Situated learning and advanced literacy skills are also discussed in this chapter. Is it better to advise non-native English-speaking scholars to 'go native' or rather stick to their culture-specific intellectual styles when writing scientific texts in English? Is it important to provide EAP students with corpus-based and cross-cultural instruction to raise awareness of the effects of plurilingualism and multiculturalism in scientific communication? Indeed, these are issues of the greatest concern for applied linguists, rhetoricians, EAP/ESP researchers and scholars in the contrastive rhetoric field as well as for EAP/ESP instructors, translators, editors and language brokers and, of course, all those plurilingual scholars from non-Anglophone backgrounds who wish, need or want to publish their research in English.

Multiculturalism and plurilingualism are of particular relevance at a time when the diversity of languages elsewhere seems to be counteracted by the prominent sociolinguistic status and growing spread of English as the current lingua franca for communication in institutional contexts. Taking a sociolinguistic slant, and relying on the findings reported in the previous chapters, Chapter 7, entitled 'ELF and a More Complex Sociolinguistic Landscape', assesses the possible perpetuation of English as the lingua franca for research dissemination worldwide and discusses whether geopolitical 'core' centres can really be challenged in favour of 'peripheral' multilingual centres. It also takes into consideration the rising commodifying forces in universities worldwide described in Chapter 2. In doing so it furthers the debate on the broad issues on hegemony and pluralism and on specific issues such as the geopolitics of academic English and the possible discursive marginalization or even exclusion of the diverse academic English*es* (my own emphasis added) in contemporary scientific discourse. The chapter finally discusses the situation of other scientific languages in the multicultural global map that might be taking up, as is the case of the French, German, Portuguese and Spanish languages.

The chapter reports on the effects of the geopolitical position of the United States, Europe and Asia's knowledge-intensive economies in the global academic and research context (also referred to in Chapter 6) to offer a critical view of the strategic interests in language planning and language policies in academia across geographical locations worldwide. These decisions might

heavily influence academic interactions and research collaboration in the future in as much as cooperation relies on effective communication through the use of a common language. The scope of linguistic policies discussed in Chapter 7 should unquestionably approach the maintenance of L2 multicompetence, cultural diversity in scientific discourse, even if the geopolitical intrusion of English in the scholarly world is inevitably subject to the decisions made in the political, economic, industrial and technological sectors.

Drawing upon the considerations above, Chapter 7 finally draws on the current debate on the extent to which the dominance of English in transnational publications affects the scholarly practices of the non-Anglophone academics in the following respects. The dominance of English and the pressure to publish in English may be forcing these academics to accept the pragmatism of 'going native' in an 'English-only' research world (Belcher 2007), even if this may none the less have a negative impact on the richness of cultural diversity as reflected in contemporary scientific discourse practices. Seen as a standardized language, scientific ELF may also be regarded as a threat to other national languages and to the eventual 'epistemicide' of culture-specific scholarly traditions (Bennett 2007, 2011). But, as discussed in the chapter, as a 'language for communication' and not a 'language for identification' (House 2003), ELF may also be portrayed as an opportunity as it is the linguistic means that guarantees effective and successful scholarly interactions across native English and non-native English-speaking communities of researchers.

The current hegemonic position of the United States and the established order of discourse in academia makes it difficult, but not completely impossible, to diminish the predominant status of ELF in the domain of scientific communication. Discarding views on the dominance of English as a form of linguistic imperialism (as documented by Canagarajah 1996, 1999, 2002a,b, Ammon 2000, 2001, 2006), this chapter and the volume as a whole advocate the maintenance of the dynamic interaction of central vs peripheral research communities and encourage the acceptance of hybridization traits for the benefit of transnational scientific research communication. The very end of the chapter seeks to persuade readers to reflect on small-scale language educational and university policies, perhaps more practicable to implement than large-scale initiatives, with the aim of better catering for non-native English scholars' language needs worldwide. Attentive to language planning intervention, consideration is given to possible linguistic policies that may help redress linguistic inequities, along with suggestions for how EAP instruction should adapt to the specific idiosyncratic linguistic needs of scholars from different cultural contexts and with different languages.

Finally, Chapter 8, 'Re-Defining the Rhetoric of Science', cuts across the quantitative and qualitative analyses and discussion in previous chapters with the aim of revising the initial conceptualization of scientific discourse described in Chapter 3. On the basis of the evidence presented in previous

chapters, the standard discourse of science will be portrayed as a complex textual typology in tune with the ongoing global and contextual demands but always stepping inside the boundaries of normative generic conventions agreed upon for effective scientific communication. The rhetoric of globalization underpinning scientific discourse represents a successful and, at the same time, flexible response to global communication trends, challenges and dilemmas. Such view strengthens its multifaceted metaphorical conception encompassing guiding principles, community conventions, complex historicities, genre colonies and networks and institutional constraints. Further, such view integrates the textualization, organization and contextualization of scientific genres and links the textual products with the scholars' community procedures and discourse practices for interaction. The above interrelatedness in turn shapes the generic integrity and its dynamics. Only if we conceive scientific genres as built upon a multilayered scaffolding – the socio-cognitive, the ethnographic, the contextual and the institutional – can we understand 'generic integrity' and 'genre mixing' (Bhatia 2004) in the scientific genre repertoire. The generic integrity of contemporary scientific discourse, as seen later, indeed becomes a faithful reflection of the complex communicative realities of the global village and its increasingly multidisciplinary and collaborative research activities. As argued in this chapter, these observations set the power and politics of scientific discourse in the contemporary research scenario and stress the importance to reflect on discourse and on the conception of language as 'fully attached to "other stuff": to social relations, cultural models, power and politics, perspectives on experience, values and attitudes, as well as things and places in the world' (Gee 1996, p. vii).

The current effects of globalization in research settings bring to the fore the complex nature of global, transnational communication. Rather than conceiving English as a 'tyrannosaurus rex' (Swales 1997, Tardy 2004, Ferguson 2005), the overwhelming number of non-native English scholars who use English as a language for communication in their everyday research activities points at gained perceptions of academic English*es* at the multicultural crossroads. A final note to educational implications and intercultural communication sensitivity is also provided in the light of Clyne's (1996, p. 214) remark that 'biculturalism – and therefore an active command of more than one communicative style (their own and a modified version of that of the "dominant" group, to which other styles are converging) – is desirable'. It is hoped that what follows will show how an influential discourse such as that of science can offer fruitful insights into culture(s) and language(s) and on new forms of academic and research interdependence in today's global village.

Chapter 2

Scientific English in the Postmodern Age

Knowledge Production, Commodification and Globalization

Like architecture, literature, art and many other cultural and intellectual manifestations, scientific knowledge production and dissemination in the twenty-first century endorses the tenets of the postmodern age. As envisaged by Kuhn 50 years ago in *The Structure of Scientific Revolutions* (1962), applying the cultural lens to scientific procedures, practices and products brings to the fore the intricate character of contemporary scientific communication and, more specifically, its intellectual, social- and contextually driven frames of reference. These frames can be said to coalesce in the following dichotomies: institutionalized discourse conventions vs discipline-specific research procedures and discourse practices, adherence to established standard rules vs deviation from those rules (i.e. the hybridization of discourse), use of genre conventions vs cross-cultural and cross-linguistic rhetorical variation and interdisciplinary conversation vs a diversity of ways of thinking across what Becher and Trowler (2001) adroitly depict as the different 'academic tribes and research territories'.

The effects of the postmodern age have been methodically discussed by the French philosopher Jean-François Lyotard in his influential work *The Postmodern Condition* (1984). They can be roughly summarized as follows: the emergence and development of computerized societies on the one hand and, on the other hand, the 'changing nature of knowledge' in artistic/aesthetic, intellectual and cultural manifestations of the time (in Sarup 1993, p. 195). In the postmodern age, the production of scientific knowledge is no longer gestated in the ivory tower of the isolated scientist. Instead, knowledge is nurtured by interdisciplinary views, by a much broader information scope including both printed and online resources and by greater interconnectedness among scholars themselves thanks to the digital technologies and shared research resources and infrastructures. UNESCO Science Report 2010 (Schneegans 2010) further refers to integrated research policies placing greater focus on sustainable research, technological development, as

well as innovation, transferability and applicability for the sake of satisfying society's challenges. Along similar lines, the EU Annual Report (European Commission 2010) recommends an integrated research and innovation policy that avoids fragmentation and broadens participation by engaging in collaboration. This changing nature of knowledge production and dissemination, gestated and stimulated by international networks and research partnerships, may be taken to evoke Lyotard's view of the postmodern age – a growing use of information systems, complex data retrieval by means of electronic databases, bibliographical archives, together with the creation of virtual spaces and interdisciplinary networks for interaction and knowledge sharing. Today, academic and research settings stand as knowledge-based microcosms whose existing information networks and social structures revolve around ongoing scientific enquiry, experimentation and dialogic exchange primarily targeted at yielding new knowledge. As sociologist Castells (2004) remarks, the development of the network society is the landmark of the latest social revolution.

A more critical view is that of Gilbert's (2005, p. 35), who argues that 'knowledge is the prime material of economic value', 'it is defined not through what it is, but through what it can do'. A central argument in this chapter and throughout the volume is '[t]he capacity to own, buy and sell knowledge' (p. 39). One possible analogy is that in the same way that Fairclough (1993, p. 143) refers to both commodification as 'commercialization of an object or activity that is not inherently commercial' and 'marketization of the discursive practices', the nature of knowledge production can be said to be subject to commodifying pressures. In today's world, research output represents a 'principal force of production' (Sarup 1993, p. 133). It is no longer a valueless commodity, but rather a highly value asset in political, economic and social domains. In a sense, the traditional view of science for the advancement of society and welfare is now tinged by the commercialization or commodification of scientific knowledge, the latter conceived of as a servant of the world economy.

Undeniably invigorated by technologies and computers the postmodern age has brought about radical changes in the nature of knowledge production. Initiatives on international research cooperation and an integrated research and innovation policy are the emerging trends for addressing major challenges and reach sustainable growth. Scientific research processes take place in complex laboratory workplaces in which accurate research methods, sophisticated instrumentation and software tools as well as other multifarious technological innovations facilitate in-depth research enquiry. Thanks to the mass media, the world of science is getting closer than ever to society and as a result it makes more noticeable an enhanced ethical and social obligation to society – or, to put it shortly, enhanced accountability. We are also witnesses of major changes in research procedures within disciplinary communities, with scientists no longer working in isolation, as stated above, but actively collaborating in interdisciplinary teams and communicating with both local and international

peers with the aim of producing more comprehensive scientific outcomes. Seeing scientific communication this way, one may argue that the contemporary research world brings to the surface facets of the so-called anthropology of knowledge and society (Knorr-Cetina 1981, Geertz 1983) and can thus be defined as a big 'manufacturer of knowledge production and knowledge dissemination', where knowledge is 'defined not through what it is, but through what it can do' (Gilbert 2005, p. 35) and where codes of practice on knowledge transfer aim at sustainability, economic recovery and social welfare.

Together with the changing processes of scientific knowledge production, a further analogy between the various cultural manifestations of the postmodern age and contemporary scientific discourse can also be found when looking at the scientists' research output and, more specifically, their research article publications. As a textual output for the dissemination of knowledge, scientific knowledge is reified in journal publications and the latter are thus conceived of as commodities. Scientific discourse is now seen not only as a manifestation of intellectual enquiry in search of the advancement of knowledge but also as a social product insomuch as it is conceived as a valuable asset for ranking the scientific excellence and the prestige of higher education and research institutions worldwide. Often depicted as an elitist social network, the scientific community can be considered to act as an 'order of discourse' (Foucault 1970). In this process of cultural feedback, contemporary scientific discourse largely relies on the representation of truth for knowledge dissemination (Skelton 1997). It instantiates an order of discourse in that it is controlled by certain established rules for communication and gate-keeping, advocates the will to search for truth and credibility and embraces only members of the disciplinary community.

Sarup claims (1993, p. 132) that 'with the development of postmodernism in recent years, there has been a move to "textualize" everything: history, philosophy, jurisprudence, sociology and other disciplines are treated as so many optional "kinds of writing or discourses"'. Scientific discourse may be taken to represent one more kind of writing or discourse and it in fact embeds what Sarup defines as some of the constituents of postmodern discourses – namely, eclecticism, self-referentiality, citation and fragmentation. The textualization of scientific discourse, otherwise depicted as primarily objective, has been suitably re-defined as highly interpersonal and dialogic. Recent studies on the sociology of scientific knowledge have further argued that in the past decades scientists have become increasingly aware of the difficult condition of reporting facts whose evidence is ultimately provisional by nature (Battalio 1998). As a result, socio-rhetorical and critical discourse analyses (Fairclough 1989, 1993, Berkenkotter and Huckin 1995) have even described the scientific discourse as a social discourse practice subject to issues of culture, power and ideology.

While critical debate on cultural relativism (Norris 2000) sides for or against the notion of our ultimate uncertain capacity to know the world, the postmodern

condition is interpreted as virtually the condition of distrust of any given value or ideology (Jameson 1984, Lyotard 1984, Solomon 1988). The provisionality of scientific enquiry is subtly textualized in a balanced combination of credibility (i.e. objective reporting of facts) and persuasion. For this latter communicative goal, scientific discourse relies on a neatly defined rhetorical architecture sustained upon macrostructures and rhetorical moves, as explained in the forthcoming chapter. Across both written and spoken modes, scientific discourse involves decision-making processes for textual development (e.g. use of phraseology with specific discourse functions). It embeds self-referential elements (i.e. self-reflexivity), intertextuality and citation and multimodal elements and renders the provisional nature of scientific facts through various interpersonal resources that involve varying clines of authorial stance. These resources ultimately confer speculation to the assertions and interpretations of new findings. Broadly speaking, scientific research communication encompasses what Verschueren (1999, p. 5) calls 'the *adaptability* of language':

> [. . .] the fundamental property of language which enables us to engage in the activity of talking which consists in the constant making of choices, at every level of linguistic structure in harmony with the requirements of people, their beliefs, desires and intentions, and the real-world circumstances in which they interact.

In a sense, the fundamental property of scientific discourse invites enquiry from 'the perspective of language (science and text) and the perspective of social context (science and institution)' (Halliday and Martin 1993, p. 25). This view of scientific discourse may help us understand its close resemblance to what Fairclough (1993, p. 143) coins the 'marketization of the discursive practices'. Intertwined with the text-based 'default discourse of factuality' (Bennett 2011, p. 16), the transmission of science brings to surface a complex research policy matrix. Such matrix may account for the growing institutional pressure to publish in impact-factor (English-language) journals, or reasons such as gaining prestige and recognition across disciplinary communities, universities and research institutions, hence the rhetorical and persuasive underpinning of the discourse of factuality discussed in later chapters in this volume. The following section provides several explanations for the claims on the marketization of contemporary scientific discourse.

Scientific Research and Knowledge-Intensive Economies

Research activities truly represent both opportunities and challenges to scientists worldwide. These activities buttress, as noted earlier, intranational and transnational cooperation and are often supported by the advances of

digital technologies. Technologies greatly facilitate scientific and technological exchange and often rely on an efficient sharing of human resources and infrastructures for the sake of knowledge dissemination. Further, research activities open up challenges for competitiveness and mutual benefits in a knowledge-intensive world economy.

A clear indicator of the key role of research activities in world economies is that expenditure on research and development activities has been on the increase in the past decade, obviously fostered by the need for generating economic growth and improving the well-being of society. World and international agencies engage in making global data on research production available to society. Figures from the World Development Indicators 2002 (World Bank 2002) in the past two decades clearly indicate that research is supported by national economies worldwide. Between 1990 and 2000, research and development (R&D) expenditure in terms of percentage increases amounted to as follows: Togo (8.4%), Sweden (3.8%), Israel (3.7%), Japan (2.8%), South Korea (2.7%), Switzerland (2.6%), the United States (2.5%), Germany (2.3%), France (2.2%), El Salvador (2.2%), Iceland (2.1%), Netherlands (2%), Denmark (1.9%), Egypt (1.9%) and the United Kingdom (1.8%). A few years later the Main Science and Technology Indicators 2006 provided by the Organization for Economic Co-operation and Development (OECD 2007) show that the international comparison of R&D expenditure situated Iceland first in the rank, with 1.44 per cent of the gross domestic product (GDP). Iceland was followed by the United States (1.06%), Finland (1.03%), France (0.93%), Sweden (0.89%) and Spain (0.85%), all of them scoring higher than the EU-25 (0.74%). UNESCO Science Report (2010) outlines future prospects in research development worldwide. As the quote below illustrates, national investment in R&D correlates with better economic prospects:

> China plans to raise the GERD/GDP ratio from 1.54% (2008) to 2.5% by 2020. Nigeria plans to join the world's top 20 most powerful economies by 2020 by attaining a GERD/GDP ratio comparable to that of the 20 leading developed economies. The Republic of Korea plans to become one of seven major powers in S&T by 2012 through creative technological innovation. One of its top priorities is to raise the GERD/GDP ratio to 5% by 2012. In the USA, the Obama administration announced plans in April 2009 to increase GERD from 2.7% to 3% of GDP. Brazil plans to raise R&D expenditure from 1.07% of GDP in 2007 to 1.5% of GDP in 2010.

Financial indicators such as the percentage of GDP further hint at unequal research policies. The World Development Indicators 2011, a world report covering 213 countries, reported recently that world research and development expenditure amounted to 2.08 per cent of GDP in 2007, only surpassed

by that of the OECD members (2.29%). Europe and Central Asia accounted for 0.87 per cent, East Asia and Pacific for 1.44 per cent and South Asia for 0.79 per cent.

National statistics agencies likewise map out research performance at local enclaves. In 2007 the National Science Foundation (NSF) defined the US research activities as a progressively more international and collaborative enterprise. Over the last decade, first the United States and second the European Union were the leaders in science and technology research, followed by China, Japan and Asia-9 countries (India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand and Vietnam). A broader picture of the research landscape places the United States and the European Union again in the lead of R&D expenditure. The Science and Engineering Indicators of the NSF bring to the surface three predominant geographic locations in 2007: North America, Asia and Europe. 'North America accounts for 35% ($393 billion) of worldwide R&D performance; Asia, 31% ($343 billion); and Europe, 28% ($313 billion). The small remainder, approximately 5%, reflects the R&D of countries in the Latin America/Caribbean, Pacific, and Africa/Middle East regions.' This picture, though, has been shifting progressively, as the NSF report states that 'while total worldwide expenditures have increased about seven per cent per year on average, the per cent growth in the Asia/Pacific region has outpaced this average, with most of the increase coming from China, India and other developing nations' (<http://www.nsf.gov/statistics/nsb100>, 8 August 2011).

A major trend in the research landscape of knowledge-intensive economies is stronger research cooperation. Thomson Science Indicators (Thomson Scientific 2007) likewise point out the growing trend towards multi-author papers as a sign of scientific collaboration in research activities of common interest:

> The numbers of scientific papers published with more than 50, 100, 200 and 500 authors plateaued from 2000 to 2003, then experienced a sharp increase in 2005. That year, each group reached its all-time highest levels. More than 750 papers with 50 or more authors were published in 2005, compared with a little more than 500 the previous year. Papers with more than 100 authors grew by more than 50 percent from 200 from just over 300 in 2003 to an impressive 475 in 2005. Interestingly, papers with 500 or more authors increased from 40 in 2003 to 131 in 2005. This group saw the largest jump of all – a 200 percent increase.

Of particular interest for the present volume are, for instance, the figures that the NSF provides regarding increased international collaboration in the fields of science and engineering. Table 2.1 lists the countries/economies with more than 5 per cent of international collaboration in 2008. Article output

Table 2.1 Percentages of international collaboration on S&E articles (1998 and 2008)

	Share of country's/economy's total article output		**Share of world's internationally co-authored articles**	
Country/economy	1998	2008	1998	2008
United States	20	30	44	43
EU				
France	38	52	16	14
Germany	36	51	20	19
Italy	38	45	10	9
Netherlands	40	52	7	6
Spain	34	45	6	8
United Kingdom	32	49	19	19
Other Western Europe				
Switzerland	50	65	6	6
Asia				
China	26	25	4	11
Japan	17	26	10	9
Asia-8	23	30	7	12
Other				
Australia	31	45	5	7
Canada	34	46	10	10

Source: Thomson Reuters, SCI and SSCI, <http://thomsonreuters.com/products_services/science/>

count is based on journals listed in the Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Internationally co-authored articles are defined as having at least one collaborating institution from the indicated country/economy and an institution from outside that country/economy.

Other interesting data retrieved from the Science and Engineering Indicators 2010 report are those concerning the growing international collaboration in science and engineering articles in the decade 1998–2008. The international collaboration index shown in Table 2.2 is obtained by measuring the first country's rate of collaboration with the second country divided by the second country's rate of international co-authorship. Again, the whole count of articles is based on journals listed in the Science Citation Index (SCI) and Social Sciences Citation Index (SSCI).

From the data illustrated above, several facts underlying these figures should not escape the notice of applied linguists, rhetoricians, EAP/ESP researchers and instructors, translators of scientific texts and other potential readers of this volume. First and foremost, there is an increasing use of international databases to benchmark research output production, as detailed in the section below. Thomson Reuters' Web of Science (WoS), including Science Citation Index (SCI), the Social Science Citation Index (SSCI), and the Arts and Humanities Citation Index (A&HCI), is the most popular one for measuring research

Table 2.2 Index of international collaboration on S&E articles: 1998 and 2008

	International collaboration index	
Country/economy pair	1998	2008
North/South America		
Canada–US	1.21	1.18
Mexico–US	1.01	1.03
US–Brazil	0.87	0.89
Argentina–Brazil	4.33	5.32
Mexico–Argentina	2.99	3.74
North Atlantic		
UK–US	0.67	0.74
Germany–US	0.68	0.68
France–US	0.56	0.60
Canada–France	0.63	0.74
Europe		
France–Germany	0.74	0.91
France–UK	0.73	0.87
Germany–UK	0.68	0.86
Belgium–Netherlands	2.50	2.68
Italy–Switzerland	1.51	1.38
Poland–Czech Republic	2.15	3.48
Hungary–Germany	1.23	1.34
Germany–Czech Republic	1.27	1.46
Scandinavia		
Finland–Sweden	3.39	3.98
Norway–Sweden	4.10	3.96
Sweden–Denmark	2.88	3.38
Finland–Denmark	2.36	3.15
Pacific Rim		
Japan–US	1.03	0.89
China–US	0.82	0.97
South Korea–US	1.38	1.23
Taiwan–US	1.44	1.23
China–Canada	0.66	0.73
Japan–Canada	0.59	0.55
Asia/South Pacific		
China–Japan	1.53	1.38
South Korea–Japan	1.99	1.90
Australia–Singapore	1.93	1.70
Australia–China	1.05	1.14
Australia–New Zealand	4.28	3.80
India–Japan	0.94	1.12
India–South Korea	1.61	2.19

Source: Science and Engineering Indicators 2010, < http://www.nsf.gov/statistics/seind10/>

performance. Second, research output is mostly materialized in research articles published and cited in WoS-indexed, English-language journals. Third, compared to the benchmark of research performance in the biological, physical sciences and technological fields, there are possible biases in the coverage of

databases to identify research output production in social sciences and humanities. Archambault et al. (2006, p. 340) explain that there is overrepresentation of English-language journals in some of the major databases such as those of Thomson Scientific, disregarding the 'greater importance of local journals and languages' in the social sciences and the humanities. Another bias observed by these authors is that scientific publications in these fields are not only research articles and abstracts, the two main sources used for indexing publications and citation statistics, but also books. The fact that bibliometrics may not be accurately reflecting the research dynamics in the social sciences and the humanities means a comparatively lower amount of scientometric data in these fields of research and less visibility for science policy goals and economic interests. These goals and interests are explained in the following section.

Research Outputs, Ranks and Indexes

In the past decade, bibliometrics has become a flourishing field of research, an essential standard tool of science policy for the measurement of national research profiles in the different world countries and regions and gradually expanding to local higher education and research institutions. On the basis of the number of peer reviewed research articles, bibliometric indicators measure the research production of academic staff in universities and research institutions worldwide. Undeniably, the mapping of scientific knowledge production is traced, as seen previously, through publication and citation statistics. These rely on peer reviewed articles, and the same applies to the major compilations of science indicators such as the National Science Board, the Observatoire des Ciences et des Techniques, the European Report on Science and Technology Indicators, Het Nederlands Observatorium van Wetenschap en Technologie: Wetenschaps- en Technologie-Indicatoren and Vlaams Indicatorenboek (cf. Glänzel 2003, Glänzel and Schubert 2004, Glänzel et al. 2007).

Journal ranks put forward scientific research output across different scenarios, the latter set upon indicators such as impact factor, publication profiles (in terms of funding, subjects, disciplines, etc.), journal influence index or paper influence index, to name but a few. Consulting these ranks lends evidence of research quantity and performance; for instance, we know that the United States stands as the world's leading country concerning the impact of its research worldwide (this impact measured by the number of citations), followed by the European Union and, some way behind, by China, Japan and Asia-8. The main explanation for the US lead can be attributed to the government's active fostering of science and engineering capacity in order to compete with other knowledge-intensive economies.

Bibliometric data and electronic availability of research publications facilitate calculation of world scientific production and evaluation. Using Thomson

Reuters databases (covering 12,000 international and regional journals in sciences, social sciences, arts and humanities) and Open Access, Björk et al. (2008, p. 4) report that 'the total annual number of peer reviewed articles in 2006 was 1 346 000 (rounded off) with 70% covered by the ISI'. On a related manner, bibliometrics serves to rank institutions on the basis of research publication output. World famous Shanghai Jiao Tong University's Academic Rank of World Universities rates higher education institutions according to the following criteria: quality of education (10%), size of the institution (10%), quality of staff (40%) and research output (40%). As for quality of staff, the number of highly cited researchers in a number of fields counts up to 20 per cent. Research output is measured according to the number of articles published in *Nature* and *Science* between 2005–9 (up to 20%) and the number of articles listed in Thomson Reuters' Science Citation Index Expanded and Social Sciences Citation Index in 2009 (up to 20%).

In addition to allowing scientists to search for scholarly publications, automatic citation indexes offer the possibility to track how journal articles are cited in subsequent publications. Bibliometric data based on ISI indexed journals, for instance, further indicate growing international collaboration in R&D activities, and the existence of scientific networks and co-authorship practices in research dissemination, as shown in Table 2.3. Remarkably, the absence of other world countries in the table indicates that governments do not always invest substantial resources in contributing to build the necessary research infrastructures and provide support for R&D activities on an egalitarian basis.

Metrics is also useful for comparison purposes. For instance, The International Comparative Performance of the UK Research Base (Department of Business, Innovation and Skills 2009) reported that the United Kingdom

Table 2.3 Percentage of S&E articles, citations and international citations (1998 and 2008)

	Share of world articles		**Share of world citations**		**Share of world/ country/economy citations that are international**	
Country/region	1998	2008	1998	2008	1998	2008
World	100.0	100.0	100.0	100.0	60.2	66.3
United States	34.0	28.9	46.9	38.3	46.9	51.8
EU	34.6	33.1	32.4	33.2	43.7	49.4
China	1.6	5.9	0.6	4.3	63.6	51.0
Japan	8.5	7.8	6.8	6.3	60.7	68.6
Asia-8	3.6	6.8	1.5	4.6	61.8	65.3

Source: Thomson Reuters, SCI and SSCI, http://thomsonreuters.com/products_services/science/

published 91,723 papers indexed by Thomson Reuters in 2008, but its output fell 'slightly to 7.9% of world papers'. A relatively similar drop was experienced by the United States which decreased from 34 to 29 per cent of world share over the period. As the report observes, this change is due to 'China's four-fold growth in ten years to over 110,000 papers in 2008. Iran, Brazil and South Korea increased their share' (2009, p. 4). These figures also evince that world research output is mainly measured on the basis of the number of published journal articles.

A note should be made here on the fact that scientometry based on ISI databases (SciSearch) has been criticized for not providing an exact measure of scientific productivity across disciplinary domains because the impact of publication may be underestimated. Repanovici (2010, p. 6) argues, for instance, that 'the causes may be the lack of impact of the field of research, the fact that [the scholar] works in a small field or publishes in a language other than English or publishes only in books'. Other alternative metric methods have then been reported. For instance, log analysis (Nicholas et al. 2005), free software Publish or Perish (Harzing and Wal 2009), the Google Scholar h-index (Dumitru 2008, Repanovici 2010) or ACI (Autonomous Citation Indexing) systems like CiteSeer for interdisciplinary fields of research with web-based publications (Goodrum et al. 2001) have been proposed. However, citation impact of journal research articles remains the agreed criterion of excellence and measurable scientific output is, to date, the main indicator to keep track of research productivity in knowledge-intensive economies.

Alongside research publications, the significance of research output becomes clearly visible in the development of specific research initiatives such as the European Research Area (ERA). ERA was created in 2000 with the aim of cross-fertilizing research activities and strengthening research excellence across Europe. ERA seeks to optimize European-based human resources and infrastructures by means of both national and regional research programmes and promote knowledge dissemination through transnational collaboration. In 2003, the Third European Report on Science & Technology Indicators (European Commission 2003) proposed a ten-year strategy for turning the European economy into a powerful knowledge-based mechanism and seeking to boost the creation of research and educational networks within Europe. More recently, the European Commission's (2007) report, Towards a European Research Area. Indicators of Science, Technology and Education, proudly refers to the European Union as 'the world's largest producer of scientific output, as measured by its share in the total world number of peer reviewed scientific articles'. The report also underlines how the world shared figures of scientific publications in the 27 EU countries accounted for 38.08 per cent of the total world production in 2007. Remarkably, the European Commissioner Designate for Research, Innovation and Science at that time emphasized the value of research for the development of a strong knowledge-based economy

and compared 'refined knowledge' to 'crude oil as the economy's prime motive force' to address society's challenges. On a related manner, other emerging initiatives are, for instance, those fuelled by the European Research Council (ERC) proposed by the European Commission under the Seventh Research Framework Programme (2007–13) and founded to strengthen the excellence of European research (across the fields of social sciences and humanities, mathematics, physics, information and communication technology, earth sciences, universe and life sciences). The Programme supports 'frontier research carried out by research teams competing at European level' and has an investment of 50,000 million euros to develop European collaborative research.

The European Commission's (2008, p. 61) report, A More Research-intensive and Integrated European Research Area Science, Technology and Competitiveness: Key Figures Report 2008/9, claims to draw heavily on the idea of a knowledge-based economy, energized by innovation, research transferability and applicability. While proudly stating that the EU-27 was the main producer of peer-reviewed scientific articles worldwide (37.6% in 2006), it nonetheless observes that the United States contributed more to high-impact publications and that China was the country experiencing the highest increase in the share of world scientific publications. In 2009, world data retrieved from Science Metrix/Scopus (Elsevier) on world shares of peer-reviewed scientific articles (%) indicate that the European Union accounted for 37.7 per cent of the total world shares while 31.8 per cent corresponded to the United States. These were followed at a distance, by Japan (9.4%), China (6.4%), the Russian Federation (3.1%), India (2.3%), EFTA (2.3%), South Korea (1.7%), Brazil (1.4%) and Israel (1.1%). As one may expect, the number of peer-reviewed research papers is always positively correlated to public expenditure in R&D and with the highest population levels.

The 2009 report of the Community Research and Development Information Service of the EU (CORDIS 2009) envisages new horizons for the post-2010 period, one of these horizons being a 'knowledge intensive future for Europe'. Partly resulting from the Ljubljana Process in 2008, the implementation of research policies for promoting competitiveness and innovation in Europe is targeted at raising 'the effectiveness, efficiency and attractiveness of the whole European research system', as the CORDIS foreword reads. A related policy concerning the Statistical Classification of Economic Activities in the European Community refers to both research development and education as being key activities for developing the knowledge intensive future for Europe. The relation between research and education in Europe is borne out by the fact that a substantial amount of research output comes from universities and research institutions ascribed to them.

Data from the World Development Indicators 2011 (World Bank 2011) provides detailed information on the number of science and engineering journal articles published in the period 2006–10. The United States scores a total of 209,695

articles, followed by China (56,806), Japan (52,896), the United Kingdom (47,121), France (30,740), Canada (27,800), Italy (26,544), Spain (20,981), Australia (17,831) and the Netherlands (14,210). Broadly speaking, figures on estimated world expenditure and scientific knowledge production somehow confirm the idea of core vs periphery geopolitical spaces and imply something different from Giddens's conception of globalization as interrelatedness and cooperation. They rather entail issues of competitiveness among knowledge-intensive economies. A closer look at knowledge production trends is provided in the following section.

Universities and Publicly Funded Research – The Global Milieu

In the twentieth century, the United States was incontestably the major geopolitical centre taking a leading role in both scientific and technological development, research productivity and societal welfare worldwide. Due to its sociopolitical and economic supremacy, the United States has been at the forefront of science and technology development, the latter nurtured by research universities. Meanwhile, geopolitical fragmentation during and immediately after the Second World War kept Europe at a standstill until the European Union was created, initially marking the beginning of the reconstruction of post-war Europe. Since then, the political and economic integration of European countries has continuously been promoted. The creation of common economic institutions and policies has strengthened the European territory through economic coordination and mutual cooperation, gradually turning it into another geopolitical core centre. China and Japan constitute the major research area in Asia, and are leaders in science and technology research infrastructures.

The origins of the European university system differ from the US system in many respects. First, nearly all European universities are public institutions controlled by Ministries of Education. Second, Europe holds a long-standing tradition in higher education – the first universities being those of Salerno (ninth century), Bologna and Oxford (eleventh century), Paris and Modena (thirteenth century) and Cambridge, Naples and Salamanca (thirteenth century). Before the Second World War, universities were more oriented towards teaching/learning rather than researching. This may be one of the reasons why, compared to the United States, Europe has fewer universities that act as major high-impact research centres. However, this situation may be changing. With the European Convergence in Higher Education, universities in Europe are turning into more autonomous and competitive entities, more concerned with innovation and social development. While scientific production stands as a key indicator for excellence, other indicators such as the number of research projects a university/research institution participates in or transnational cooperation research partnerships are also highly valued.

In the European geographic area the Bologna Process is specifically targeted at reforming Higher Education and enhancing educational cohesion at a transnational level. This process currently underpins a political effort to strengthen economic stability and ensure growth prospects. It is worth recalling that after the publication of the 'Study on the economic and technological evolution of the scientific publication markets in Europe' in 2006 the European Research Advisory Board (EURAB 2006) encouraged the policy on open access journals to facilitate knowledge dissemination through scientific publications all across Europe. This was a challenging initiative to strengthen research in the European geopolitical core centre. Institutions like the European Research Era (ERA) founded in 2007, the European University Association, the Center for Higher Education Policy Studies and the Higher Education Development Association support the synergy between economic development and the transferability of the basic research knowledge produced at universities.

Following the lead of the United States concerning policies in higher education, the current European ruling university system is aimed at achieving excellence in the fields of teaching, research, knowledge transfer and innovation. The so-called Excellence initiative programmes, started a few years ago in many European countries, are specifically designed to put universities at the top of the academic rank and by this means attract students and scholars. Recalling the knowledge-based model illustrated above, the specific research-oriented policies implemented under the Seventh European Framework Programme seek to prioritize competitiveness in terms of knowledge production, educational challenges and socio-economic and scientific advancement. The ERA Green paper report published by the European Commission in April 2007 established as progress indicators for measuring efficiency, competitiveness and growth the following: research institutions, research programme funding and research infrastructures, mobility of researchers, transnational knowledge flows and internationalization of research activities. The highly competitive environment can thus be noted in the use of bibliometric indicators of research output production at both intranational and pan-European levels.

The third major geographical area of academic research-based knowledge production is represented by Asian universities, above all those located in China and Japan. These two countries constitute the major research area in Asia, and are leaders in science and technology research infrastructures. Japan has a large network of both private and public universities, at present reaching 600 of which only 90 are national universities. Following the US model, Japan's main concern has been to create effective systems for transferring technology-related research to industry with the aim of enhancing the competitiveness of the latter. Another concern is to strengthen university research environments, for which the Ministry of Education and Science started in 1995 a special programme for Centres of Excellence (COE) (Stenberg 2004, p. 57). The Japan

Policy Research Institute specifically 'seeks to produce high-quality research and publications, as well as to sponsor conferences, public events, and service activities in order to foster dialogue and cooperation among scholars' <http://www.jpri.org/about/index.html>. Put it simply, the promotion of cooperation between industry, universities and governmental R&D institutions is given priority by the Japanese science and technology policy.

Chinese universities were created in the late nineteenth and early twentieth centuries to act as teaching institutions, leaving research activities targeted at developing technological research in the hands of the institutes of the Chinese Academy of Sciences. It was not until 1978 that a major reform transformed Chinese universities into research centres, which gained greater prestige when a decade later they began to be supported by the National Natural Science Foundation of China. The Institute of Higher Education at the Shanghai Jiao Tong University runs the well-known Shanghai Ranking of top universities worldwide. Of note, China's interest in developing 10–12 national universities and turning them into world-class universities involved an investment of approximately 1.26 billion euros during 1999–2003 (Brandenburg and Zhu 2007). Following similar policies, the Chinese Academy of Sciences funding of the Knowledge Innovation Programme was particularly fruitful in promoting the role of universities and research institutions in order to intensify research and innovation and develop technology-related entrepreneurial activities (Suttmeier 2002). For the past decade the US–China Cooperation Programme in Science Policy, Research and Education, started in 1999, has consolidated partnership and bilateral cooperation in the fields of science and engineering. Modelled on the US National Science Foundation, these scientific institutions uphold the synergy between research production within their university systems and their national science and technology systems, one of their main targets being universities' close collaboration with industry. As for international collaboration with other knowledge economies, the Sixth Forum for Chinese and Japanese University Presidents held in October 2009 a meeting with representatives from 21 Japanese and 20 Chinese universities and drew particular attention to the significance of intra- and transnational academic and research exchange as a key policy for the development and growth of their knowledge-intensive economies. Having set the leading scenario, it should be noted that the amount of basic research produced by universities is nowadays a major indicator of excellence for ranking higher education institutions. Indicators of excellence primarily rely on citation indexes to retrieve, for instance, the list of top-ranked institutions or to make decisions on how to distribute funding on the basis of research productivity.

In the 1970s, the North-American universities started to take a more prominent role in the science and technology system. Prior to the Second World War they became research-oriented institutions and today 'continue their remarkable record of success' (Atkinson and Blanpied 2007) worldwide.

The US university system is further supported by the authoritative roles of the National Science Foundation, the National Academy of Science and the National Research Council, which counsel the government in science-related matters. Behind large-scale shared research capacities, infrastructures and collaboration there then lie 'funding bodies demanding innovative approaches to grand challenge questions' (Harley et al. 2010, p. 16).

The Center for Measuring University Performance supervises competitiveness within the US national context and resorts to incentives and reward systems for promoting research output in universities and maintaining national rankings (cf. also World Bank Development Indicators). Harley et al.'s (2010, p. 7) study of 45 US universities and research institutions and qualitative, interview-based data with a total of 160 scholars across different disciplinary domains, concludes that publishing research in peer-reviewed prestige journals is the key indicator guaranteeing tenure and promotion decisions and that the concept of 'excellence' in the US higher educational context assumes that

> a scholar's work is widely read, is judged to be of high quality by internal and external reviewers, and advances the field. Adjectives such as 'groundbreaking', 'creative', 'original', 'transformational', 'high impact on the field', 'indicative of sustainable scholarship' and 'lauded by the larger community of scholars' are just some of the descriptive criteria that are used to judge the quality of a scholar's work [. . .].

The second issue shaping the current academic and research context worldwide is that of international and transnational cooperation. The three leading competitors, United States, Europe and Asia have world-class research universities and their bids for excellence illustrate a highly competitive global landscape. Mobility becomes a key factor in research activity and research dissemination. US institutions hold research projects not only inside but also outside the country, particularly with Japan, China and Korea. Even if Asian countries have top-ranked universities and research institutions (cf. Altbach and Umakoshi 2004), Chinese, Japanese and Korean students are awarded PhD grants for conducting doctoral studies in US universities, hence becoming one of the main clients of North-American research institutions. European universities, which are currently immersed in the Bologna Process and gearing towards a Convergence in Higher Education policies, foster staff and student mobility across European countries and seek excellence to attract students from abroad. Through funds awarded by the Seventh Framework Programme researchers are encouraged to establish trans-Atlantic projects with major US institutions. These strategic partnerships seek to heighten cooperation and research developments.

As active agents for the dissemination of disciplinary knowledge, higher education institutions are unquestionably taking a major role within the current

geopolitical core centres. Within the dynamics of knowledge-intensive societies, higher education institutions are expected to become sensitized towards societal changes and challenges and interested in approaching complexity from interdisciplinary perspectives. In the search for the creation and maintenance of an efficient research system, closer cooperation is being sought between research and education. The exigencies of research activities call for the need to develop partnerships and interdisciplinary joint efforts across academic and research network communities. The bid for disseminating research results, fostering coordinated interdisciplinarity and increasing transnational collaboration – the three aspects raised in the interview protocols described in Chapter 5 this volume – are inevitably linked to socio-economic demands. A higher level of integration of sophisticated research systems among particular geographical areas entails greater transnational funding of research and development in those research locations. That said, we turn to the specific role of universities at the turn of the second decade of the twenty-first century.

Accountability, Transferability and Applicability of Knowledge

In the context of increased transnational cooperation, common research infrastructures are provided to scholars in order to bring resources together. The European Commission's website (http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=what) shows that key infrastructures attracting researchers from around the world can be classified into three major types, single-sited, distributed and virtual infrastructures. Single-sited infrastructures are single research resources at a single location. A good example of the scope of transnational sharing of research infrastructures is well-known European Organization for Nuclear Research's CERN, the world's largest laboratory of particle physics. According to the European Commission's website, this intricate, top-quality research infrastructure is used by 6,500 researchers from 80 different countries. Distributed infrastructures involve large data archives and repositories in different countries which jointly draw on a single web interface for user access. European Mouse Mutant Archive (EMMA) is used by partner institutions for collecting and sharing basic biomedical research data. Virtual infrastructures like the pan-European Géant high-speed network developed under the Fifth Framework Programme successfully provide electronic-mediated services for scientific collaboration. These integrated infrastructures offer facilities, resources and services to researchers from different locations and hence play a key role in the advancement of multidisciplinary and interdisciplinary knowledge. As such, they are intrinsically related to social, political and economic interests and demands. It is thus of interest to understand the operational scope of these large-scale infrastructures across transnational frontiers, as described in the following quote:

> [infrastructures] used by the scientific community to conduct top-level research in their respective fields, ranging from social sciences to astronomy, genomics to nanotechnologies. Examples include singular large-scale research installations, collections, special habitats, libraries, databases, biological archives, clean rooms, integrated arrays of small research installations, high-capacity/high speed communication networks, highly distributed capacity and capability computing facilities, data infrastructure, research vessels, satellite and aircraft observation facilities, coastal observatories, telescopes, synchrotrons and accelerators, networks of computing facilities, as well as infrastructural centers of competence which provide a service for the wider research community based on an assembly of techniques and know-how. <http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=what> (7 October 2011)

As illustrated in Figure 2.1, the knowledge-based model of the global village implicitly suggests that an enhanced transferability of new research knowledge production to both education and society's welfare is the prioritizing policy. Knowledge is disseminated through education which in turn encompasses scholars conducting research activities at higher education institutions. At the same time, knowledge is transferred, that is, materialized, into ongoing developments in society in response to society's own demands, changes and challenges. Education is expected to be in tune with new research and innovation interests and, on the basis of these interests, equip future generations of professionals with the necessary employability skills.

As a comparative aspect of competitiveness in today's knowledge-intensive economies, economic performance is said to be sustained by the economic benefits of publicly funded research. It was argued earlier that new knowledge

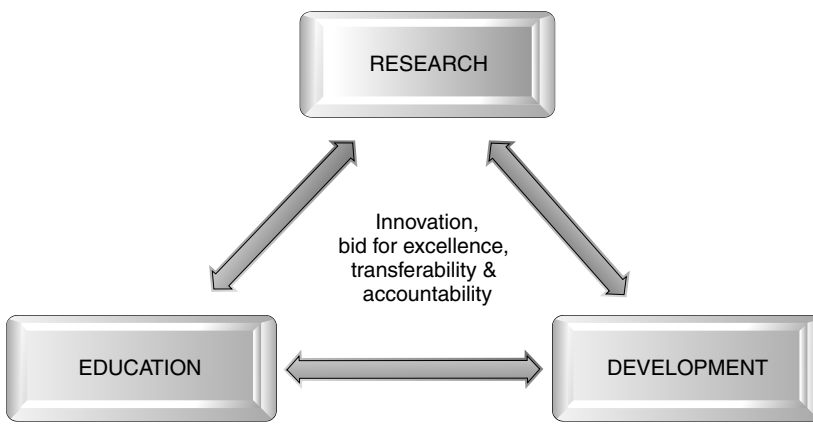

Figure 2.1 The knowledge-based model of the global village

is a public asset and that is has become marketized – or commodified. Commercialization of publicly funded research brings with it applicability, transferability and accountability that benefit society at the social, human and economic levels. Martin and Tang (2007, pp. 14–15) refer to various interrelated, overlapping contributions of academic, publicly funded research with regard to a country/region's economic performance: increasing the stock of useful knowledge as well as the capacity for scientific and technological problem-solving and creating new firms, training skilled graduates, developing new scientific instrumentation and methods, forming outside global networking and invigorating social interaction.

Salter and Martin (2001, p. 517) contend that academic work is increasingly important for research-based activities such as pharmaceuticals, petroleum, chemicals or food, among others. These authors further argue that academic work is also relevant for development activities in the industrial fields of computers, aerospace, motor vehicles, telecommunications and electronics. As these authors (2001, p. 529) conclude,

> [. . .] no nation can 'free-ride' on the world scientific system in order to participate in the system, a nation or indeed a region or firm needs the capability to understand the knowledge produced by others and that understanding can only be developed through performing research.

Accountability is also an impending aspect of universities' dynamic with regard to publicly funded research. Hazelkorn (2010, p. 64) explains it as follows:

> Today higher education tops many government policy agendas, as is considered a vital element of the productive economy rather than social expenditure. Yet regardless of governance structure, more demands are being placed on higher education. In return for increased financial support, governments want more accountability regarding student learning; in return for more funding, governments want more income-generation; in return for greater support for research, governments want to identify 'winners'; and in return for valuing HE's contribution to society, governments want measurable outputs.

Given the feasible transferability of new knowledge gestated by research and innovation activities at universities, recent social and political endeavours have successfully challenged the perception that universities are not relevant. Universities now endorse initiatives that include diffusion and applicability of knowledge. As a result, they are gradually taking a more active social role in the dissemination and application of research outcomes. For example, the US Agency for International Development (USAID) policy invites collaboration of higher education institutions with social networks for the diffusion of

knowledge and for contributing to the sustained development of the country and of other countries worldwide. Reciprocally, this policy welcomes such collaboration with the aim of enriching US-based curricula and research with insights into global perspectives. USAID also develops strategic plans with research priorities for the US and international beneficiaries and bids for the highest quality research through consultations, evaluations and assessments of research proposals and research outcomes. In a similar fashion, China's State Science and Technology Commission invites both bilateral and multilateral cooperation, and foregrounds the need for interchange and transferability of university knowledge and industrial sectors with the goal of attaining a true balanced, people-oriented social compromise.

These views may help us understand why today, universities worldwide are incorporating plans for turning research and outreach capacity into an explicit national commodity. At a moment of global economic constraints, universities are developing strategic plans targeted at generating economic growth and strengthening corporations, hence becoming competitive entities. Higher education institutions are eager to create supportive international policy frameworks and offer incentives such as international co-authorship and international collaboration with the aim of making education and research activities comply with quality standards for international recognition, prestige and global competitiveness.

A clear example of ways of incorporating plans for tuning research and outreach capacity can be found in plurilingual Europe's convergence in higher education. The year 2010 saw European reform in higher education establishing the so-called Bologna Declaration's conception of a common European higher education area. Reforming the education system in a convergent way has involved substantial changes over the past few years: new curriculum designs for new degrees and the implementation of constructivist approaches for lifelong learning, along with the growing internationalization of universities (e.g. promoting student mobility as well as teaching and research staff mobility) and policies encouraging transferability of learning and knowledge, seeking a closer cooperation between universities and the secondary economic sector (e.g. signing cooperative agreements with enterprises and companies/firms).

Within this climate of cooperation and bid for excellence in research and education, one of the most salient commodifying factors is the value of scientific research output, as also noted earlier. On the basis of 'whether a university's scientific publications in leading academic journals are cited more often (or not) than publications in those journals are cited on average' (European Commission 2003, p. 1). European universities are ranked as top performers in terms of publications, top performers in terms of citations and top performers in terms of impact score. According to this measurement, the United Kingdom, the Netherlands, Germany, France, Belgium, Finland, Denmark

and Sweden are countries with some of the 22 European universities that achieve citation impact scores above the world average. These positive figures have nonetheless been contested to some extent. In a bibliometric study based on a 15-year period (1991–2005) Glänzel et al. (2007, p. 71) predict a changing world leadership in the fields of science and technology. The publication output indicators used for the study comprised '(i) the share in the world total, (ii) subject-based publication profiles, (iii) citation-based indicators like journal- and subject-normalized mean citation rates, (iv) international co-publications and their impact as well as (v) patent indicators and publication-patent citation links (both directions)'. The results of the study show that while EU 15 (world leader in 1995), together with the United States and Japan have represented the 'triad' of the world's largest producers of scientific knowledge for decades, the evolution of the share of publications of China is expected to turn the triad into a tetrad. As an effect of globalization and intensifying collaboration, as these authors contend, the growing Chinese universities publication output may soon reach second position in the world's rank.

Amidst this challenging landscape of competitive ranks, it is evident that universities – especially those of the major 'big' producers of knowledge – will keep on playing a key role in the development of knowledge-based economies. Salmi (2010, p. 271) explains it by stating that 'preoccupations about university rankings reflect the general recognition that economy growth and global competitiveness are increasingly driven by knowledge and that universities play a key role in that context'. The challenges of competitiveness ranks affect both big and small research contexts alike and at the same time bring to the surface issues of language(s) and culture(s). Considering that it will later be used for comparative purposes in Chapter 4 (the intercultural rhetoric account) and Chapter 5 (the ethnographic account), the case of the Spanish research context is briefly explained below.

The Case of a Local, National-Based Research Milieu

In view of the actual workforce in the contemporary research arena, the Spanish National Plan of Scientific Research, Development and Technological Innovation 2008–11 (Comisión Interministerial de Ciencia y Tecnología 2008) stated that in 2004, 8 out of 1,000 employees worked in the R&D sector. This indicator was still below the average of 9.7 for EU-25 countries. At that time, differences were even bigger if we compare Spain with Finland, Denmark and Luxemburg (with 22.3, 14.8 and 14.1 respectively). Even if the research workforce might be considered to be relatively small, its performance seemed to be increasing at a considerable pace. According to the European Commission data in 2004, Spain was 14th in the rank, with 588 articles published in ISI journals (per million inhabitants) – a rough total of 24,696 articles corresponding to

the population at that time of approximately 42 million. Although this mean was slightly lower than that of the EU-25, with 639 articles per million inhabitants, it none the less reflects that research activities and research output in Spain are fairly acceptable and 'efficient' as the report itself states (p. 36).

Although the figures above show that the Spanish research context is, to put it plainly, alive and kicking, it is also worth noting that within the Spanish territory there is a close correlation between R&D expenditure and research article output. Furthermore, there is an unequal distribution of R&D expenditure. The regions of Andalucía, Cataluña and Madrid score highest in research publication capacity since they profit from the highest R&D budgets. This, as discussed later in this volume, might have some impact on language policies in relation to research article publication in English. Coincidentally, universities belonging to these regional communities have language translation and language editing services that cater for scientists' linguistic needs when publishing their research in English.

Public expenditure and R&D programmes in Spain rely on indicators for measuring efficiency and advancement. An interesting issue here is the extent to which such an R&D infrastructure network is efficient or not. In a report issued by the Spanish Chamber of Commerce in 2009, Spain was revealed to hold a very disappointing 23rd position in a list of 30 countries. Switzerland, Germany, Czech Republic, Italy, Portugal, Romania, Turkey, Ireland, Slovakia and Great Britain appear to be the most efficient models of research, development and innovation. By contrast, Spain, Iceland, Estonia, Norway, Greece, Lithuania and Latvia stand as the most inefficient countries. The comparison was based on the degree of profitability according to the correlation between the number of resources and R&D national investment. In the current context of economic crisis but high competitiveness in research and educational settings, the President of the Spanish Chamber of Commerce recently claimed that only with more efficient use of R&D investment can R&D human and economic resources increase too. On December 2009 the Cabinet approved a total of 587 million euros for research projects until 2015. The Sixth National Programme for scientific research, development and technological innovation for 2008–11 presented by the Spanish Science and Technology Foundation (FECYT) is specifically targeted at strengthening areas for generating knowledge and capacity, competitiveness, cooperation and technological capacity. In this respect, an instrumental line of action is the National Programme for Internationalization of R&D which is expected to be specifically oriented towards the business sector but also encompasses public and private universities.

Like other local academic and research sites in Europe and elsewhere, in the Spanish academic and research milieu, the presence of English as an international language of academic exchange is becoming increasingly manifest. While the number of research articles published in Spanish-language journals

dropped from a total of 5,309 articles in 1996 to 2,744 in 2006, the number of articles published in English-language journals increased from 19,870 to almost 40,000 in 2006. According to the Institute of Documentary Studies on Science and Technology (former CINDOC 2007), a total of 59.65 per cent of the Spanish scientific production comes from the university and 10.12 per cent from the Spanish National Research Council (CSIC). The remaining 30 per cent is produced by the health sector, enterprises and the central administration. The Spanish Foundation for Science and Technology report on R&D activities explains that '[t]here exists a close correspondence between the number of articles published in scientific journals and the public R&D expenditure, in such a way that the regions with higher R&D investment rates are those with higher capacity for research publication' (2007, p. 40). A further indicator of the Spanish research context is provided by the Spanish Statistical Institute, which reports that researchers in higher education represent 48 per cent of the research workforce in 2007. The remaining 50 per cent is distributed among public administrations (17.5%) and the private sector (34.3%). In November 2010, the Spanish Statistical Institute's press release reported that expenditure on R&D represented 1.38 per cent of GDP in 2009. Considering that higher education workforce accounted for 47 per cent of human research resources, I now turn to this particular institutional context.

Within Spanish academia, but also taking place in other non-Anglophone locations (e.g. Poland, Hungary, Romania, Portugal or Greece, in Europe but also elsewhere, like China, India, Taiwan, Japan or Iran, to name but a few more) the role of English is clearly ascribed to what Lillis and Curry (2010) refer to as the 'politics of publishing in English' across transnational scientific communities worldwide. If we take again the case of multicultural Europe, it is fairly easy to realize that the common European Space of Higher Education has been gradually strengthening the role of English as the main linguistic tool to foster prestige and innovation outside Europe and, within it, to promote student and staff mobility across the EU-based higher education institutions. An additional major factor driving the increasing role of English as the main language in higher education is, as discussed above, the effort expended on internationalization and dissemination of research activities within and across academic and research sites. Behind these efforts one may see authoritative institutional pressures targeted at entailing competitiveness and prestige and ultimately making the European Union the leader of scientific advancement. One can certainly argue that English stands as a helpful linguistic means for academic exchange and scholarly collaboration overseas.

As in many other European countries and also elsewhere, knowledge production and research output in Spain have become valuable material goods. From the perspective of higher education institutions, research output guarantees a scholar's accreditation by the Spanish National Agency for Quality Assessment and Accreditation (ANECA). The National Assessment and Planning Agency

(ANEP) requires that every national research project disseminates the new research knowledge internationally, hence the growing interest in English-language journal publications. Similarly, the National Commission for the Assessment of Research Activity (CNEAI) awards every six years an additional salary complement to those university teachers with publications. International English-language journals indexed in ISI/JCR are the only publications guaranteeing such awards (see Curry and Lillis 2004 in other European countries, Pérez-Llantada 2007, Moreno 2010).

Of particular interest for the present volume is the fact that publications written in English by Spanish scholars very noticeably outnumber those written in Spanish, as stated earlier. As a result, national, Spanish-medium publications have been relegated to a secondary position. Researchers do not get sufficient merit for accreditation if they publish in national language-medium journals. They do if they publish in English-language publications indexed in WoS and Journal Citation Reports (JCR) databases (see also Chapter 5 for further discussion). Whether we like it or not, the overall impression of the Spanish research site and of many other non-Anglophone sites is that disseminating scientific knowledge in English is, at present, an increasingly stark choice. As explained below, this linguistic predominance is also taking place in a large number of countries worldwide.

The Impact of Language and Culture in the International Scientific Landscape

While the phenomenon of globalization has largely been regarded as the result of the increasing domination of the United States at both economic and political levels, sociologists have judiciously pointed out that globalization is essentially a technological and social phenomenon. Giddens (1990, pp. 63–4) defines it as a 'stretching process, in so far as the modes of connection between different social contexts or regions become networked across the earth's surface as a whole' with a subsequent intensification of worldwide social relations. As discussed later in this volume, the globalizing processes taking place in academia in the past few decades are marked by increasing interconnectedness and information and knowledge exchange on a global scale. In Giddens's (1990, p. 177) words, '[t]he globalizing tendencies of modernity are simultaneously extensional and intensional – they connect individuals to large-scale systems as part of complex dialectics of change at both local and global poles'.

It is a fact that academia encompasses an immense potential to generate new knowledge, knowledge that can be shared and transferred to other expert peers and to the particular disciplinary (or sub-disciplinary) community members. And it is precisely here where the globalization effects and the impact of English for the construction, transmission and exchange of scientific

knowledge across research groups and universities is worth looking at in depth from both text-linguistic and socio-rhetorical viewpoints. 'Englishization' (Swales 2004, p. 52) can be perceived as a form of power or dominance for practical reasons of mutual understanding and cooperation. Within Europe (cf., e.g. Medgyes and Kaplan 1992 for Hungary, or Ives and Obenchain 2007 for Romania), such dominance is clearly fostered by governments' bids for the development of knowledge-intensive economies, national research agencies' bids for scientific excellence and higher education institutions' bids for prestige and internationalization – all of them global bids that are measured on the basis of research outputs. As a result, this dynamic puts pressure on scholars to publish in 'English-only' journals.

As argued earlier, countries' efforts to develop knowledge-intensive economies along with the intensification of communication across social networks from both local and global poles have been strengthened by the interdependence between information technology and society's demands for open communication (Castells 2001, Castells et al. 2001). This openness in communication has fostered the use of English as the dominant lingua franca for research interactions worldwide. Phillipson (1992, 2003), Canagarajah (1996, 1999, 2002a, b), Ammon (2006), Carli and Ammon (2007), Hamel (2007) and Coulmas (2007) define the predominant status of the English language as a prescriptive monolingualism. These critical voices posit that cultural aspects of the dominant language are subsequently transferred along with the language and thus regard the spread of English as a threat to local languages and cultural traits. Altbach (2004, p. 64) cleverly narrows down these claims to the taken-for-granted 'realities of an unequal world' in relation to globalization and universities.

Arguments in support of the role of English as a tool for international collaboration at universities and research institutions become more compelling as the internationalization of research activities speeds up. In the international landscape, the impact of English as a lingua franca has altered the traditional divide between native and non-native speakers of English (cf. Chapter 7 for a detailed discussion). While, at present, the sociopolitical supremacy of English as a first language accounts for its 400 million speakers and reaches 450 million if both pidgin and creole varieties of English are included, the real importance of English nowadays relies on its use as a second or foreign language, with approximately 1,500 million speakers worldwide (the ratio of English as a first language to English as a second/foreign language being 1:3). Bearing in mind these figures, governments' worldwide initiatives targeted at the internationalization of collaboration and knowledge interchange of research/teaching activities may explain the way English has gained a leading role as the shared communication tool in the global research scenario. In this scenario, several scholarly voices have argued that non-Anglophone researchers face linguistic disadvantages when they need to use English in order to have their research published in English-language journals.

House (2003, p. 558) argues that multicompetence involves 'the possession of more than one set of linguistic and socio-cultural knowledge in one and the same individual, on language use rather than on development and acquisition and on the socio-pragmatic functions of language use'. For the purposes and scope of the present volume, the notion of a 'plurilingual' scholar is grounded in Cook's (1993) concept of 'multicompetence' (cf. also Chapter 7). A plurilingual speaker/writer is one who is competent in more than one set of linguistic and sociocultural knowledge and, on these grounds, is capable of using the language. Cook's conception of L2 uses sensibly embraces language-acquisition-related perceptions such as the fact that L2 communicative purposes are different from the speaker/writer's use of his/her L1, and the fact that the user knowledge of the L2 tends to differ from that of the native speaker (not always reaching the status of bilingualism).

In the European context, for instance, plurilingualism in scholarly settings recalls Berns's concentric circles of European Englishes (1995, p. 9): the inner circle formed by Anglophone countries, United Kingdom and Ireland, the expanding/outer circle (formed by non-Anglophone countries that use English as L2, and the expanding circle, including non-Anglophone countries where English still holds the status of a foreign language. Reportedly, some academic communities encompass a bilingual situation, with the L1 taking the leading role in everyday life and English as L2 taking the leading role in academic contexts (Gunnarsson 2000, 2001, Oakes 2005). In Germany, Luxembourg, Netherlands, Finland, Norway or Sweden among other Northern European countries, all of them in the expanding/outer circles, English is the leading language in university settings for reasons of functionality and cross-cultural communication. This state of diglossia stemmed from both educational policies, socio-economic factors and, above all, commercial and trade reasons. An ensuing consequence of this expanding circle is that the endangerment to their national languages has led countries such as Sweden or Finland to develop protectionist linguistic policies for the promotion of these national languages.

In stark contrast with those in the outer circle, in countries such as Belgium, France, Denmark, Greece, Italy, Spain and Portugal, all of them included in Berns's expanding circle, English is the primary foreign language and, in academia, it is gradually gaining significance as it facilitates staff and students' mobility and intercultural communication. The status of English in this expanding circle, probably due to sociopolitical and sociolinguistic reasons that will be addressed later in this volume, will not lead to the eventual replacement of the local languages in academic life, at least in the short run.

Ferguson (2009) conceptualizes the global spread of English with reference to issues of linguistic inequality affecting the non-native English scholarly communities. Like other EAP scholars, Ferguson argues that writing in an additional language may represent a major impediment to having one's work

published since these scholars lack the necessary linguistic competence and ease of expression. It is also an added burden in the sense that it requires extra time and effort needed for drafting, revising and, when applicable, resubmitting the article for publication. As discussed in detail in Chapter 7 of this volume, EAP/ESP scholars propose several language policies (e.g. providing editorial assistance to non-native scholars or some sort of institutional language advising and translating help) to cope with linguistic inequalities (cf. Benfield and Howard 2001) of scholars from countries included the expanding circle, in Europe and elsewhere, like Asia and Africa, for instance.

As far as the 'culture(s)' issue is concerned, to successfully publish and disseminate knowledge in today's English-dominated international research arena, scholars are expected to 'acquire not only linguistic skills, but also the preferred values, discourse conventions and knowledge content' (Canagarajah 1999, p. 147). Lack of resistance to these values and conventions may thus lead to gradual appropriation of them and eventual domain loss – as Coulmas (2007, p. 6) puts it, 'at the cost of molding [their thoughts] in a conventional form' – or at the expense of the gradual peripheralization of their national languages and rhetorical traditions. This linguistic phenomenon has been described as the 'go native trend', which becomes symptomatic of a 'steady displacement of indigenous rhetorical practices and textualizing conventions by English textual norms' (Ferguson 2005, p. 81). Leki (1992, p. 92) further observes that adapting to the established language involves not only linguistic adaptation but also cultural adaptation. He explains that while conventions of argumentation in English writing are supported by facts, statistics and illustrations, other cultures 'rely heavily on analogy, intuition, the beauty of the language, and the opinions of the learned of antiquity'. Evidence is yet another variable. Kaplan (1966, p. 10) explains that the concept of evidence – a key concept in scientific communication – is understood differently across cultures and is thus reflected differently in writing. In this same respect, Steinman (2003, p. 80) points out that non-native English-speaking scholars are indeed challenged when they need to use English as L2 for writing up research:

> Not only must they deal with the obvious linguistic and technical issues such as syntax, vocabulary and format, but they must also become familiar with Western notions of academic rhetoric. Collisions of cultures are experienced when the discourse practices L2 writers are expected to reproduce clash with what they know, believe, and value in their L1 writing. [. . .] collisions regarding voice, organization, reader/writer responsibility, topic, and identity.

The other side of the impact of culture(s) and language(s) in the past decade is that the use of English by non-native scholars tends to deviate from the standard academic English norms. A revealing example is Nickerson's (2004, pp. 121–2) observation on the way business people in the Netherlands have

developed their own intercultural conscience for intranational communication when using English as L2 as a way of demonstration of their own cultural identity. For Bondi (2007, pp. 72–3), the distancing from standardization depends on a range of intercultural reasons, first, 'the language codes used and the role they play in the communicative event', second, 'the types of identities involved in the interaction, including the patterns of symmetry/asymmetry in participant identities' and third, 'patterns of tension between identities; the acculturation vs. hybridization attitudes shown'.

Challenging the above-mentioned 'go native' trend, that is, the tendency to emulate the normative conventions of standard disciplinary discourses, the Contrastive Rhetoric (CR) field has claimed that non-native scholars tend to rely heavily on strategies from their L1 writing (Connor 2002, 2004, 2011) and that this transfer involves the use of recurring patterns of discourse organization and rhetorical conventions in the L1 language. The fact is that the prolific CR field reports substantial linguistic and discoursal variation in scientific discourse across cultural contexts and languages as varied as French, Norwegian, Finnish, Swedish, Polish, Romanian, Bulgarian, Ukrainian, Hungarian, Italian, Russian and Spanish (Mauranen 1993a, b, Vassileva 2000, Breivega et al. 2002, Blagojevic 2004, Dahl 2004, Duszak 1994, 2005, Fløttum 2005, Vold 2006, Yakhontova 2006, Duszak and Lewkowicz 2008, Giannoni 2008, Vázquez and Giner 2009, Mur-Dueñas 2010, Pérez-Llantada 2010a, b, among many others). Corroborating the claims of the CR field, Mauranen et al. (2010b, p. 647) more concisely affirm that 'alternative ELF (English Lingua Franca) versions of standard written English may be emerging'.

Partially diverging from the views above on the advancement of English across non-Anglophone research communities as a form of linguistic imperialism, and in tune with the CR's claims of culture specific distinctiveness in English scientific discourse, the stance of this volume advocates that the skyrocketing progress of scientific knowledge fruitfully nurtures from values of independent thought, freedom of expression and cooperation among peer/colleague researchers. It is precisely in this context of interaction that English becomes a necessary and efficient instrument for disseminating scientific knowledge. Contributing to the intellectual growth of knowledge-intensive economies and to enhanced collaboration among them, ELF facilitates knowledge dissemination across universities and research institutions worldwide.

Discoursal Nativization, Hybridization and Glocal Discourses

If we borrow Foucault's (1972, p. 48) concept of 'order of discourse' as 'a conceptual terrain in which knowledge is formed and produced' we may well regard the institutional context in which scientific discourse is ascribed as a

well-defined order of discourse which operates under established discursive practices, both at the local pole (i.e. the intranational scientific community) and the global pole (i.e. the international scientific community). This order of discourse further recalls Fish's (1980, p. 171) definition of interpretive communities, defined as those 'made up of those who share interpretive strategies not for reading (in the conventional sense) but for writing texts, for constituting their properties and assigning their intentions'. As in every interpretive community, the production of discourse within the scientific community adheres to a set of specific textual and rhetorical practices, that is to say, principles and restraints in accordance with its particular communicative purposes, audiences and settings.

Adopting the normative (standard) Anglophone conventions can alternatively be seen as a way of privileging one group's literacy as regards language and culture. Swales (1998, p. 4) anticipated that academic English was growing too fast and 'at too great a cost to other scholarly traditions and languages'. Durand (2006, p. 48) also criticizes the Anglophone monolingualism in as much as 'Anglo-Saxon science is promoted and perceived as the best and is constantly in focus, while other important contributions are marginalized or simply ignored'. Taking a more matter-of-fact stance, the adoption of English as the dominant language for scientific communication might even involve the gradual decrease of the non-Anglophone scholars' L1 discoursal and rhetorical practices. Although the local languages play a key role in disseminating and exchanging new knowledge at a national level, the growing preference for getting research published in English-medium publications might signify in the long run a notable decrease in local scientific exchange and communication (cf. Chapter 7).

The predominance of English in academic and research contexts has been grounded on established norms for communicating scientific research. These norms form what we call 'standard scientific English' and mainly rely on Western rhetoric. However, investigating universality (adherence to these standard norms) vs hybridization in discourse involves looking at 'specific influences that cut across cultures' that 'presuppose pre-existing sociocultural phenomena which are not hybrid' (Atkinson 2003, p. 57). Perhaps the transcultural flows taking place in non-Anglophone scientific communities somehow resemble what Fairclough (2006, p. 31) terms 'interdiscursive hybridity'. Echoing Foucault's (1970) premises on 'orders of discourse', Fairclough (2006, p. 25) defines 'discursive hybridity' as the mixing of 'discourses, genres or styles from different orders of discourse' and explains how networks of social practices affect the textual and discoursal construction of knowledge. As Fairclough (2006, p. 166) further argues:

> Texts are the outcome of dialectical relations between the causal power of more or less stabilized orders of discourse (and, at the most abstract level,

languages) and the causal power of social agents to act and produce potentially innovative 'objects' (in this case, texts) with given resources and within particular constraints.

As reported by CR research, the expression of scientific knowledge is claimed to be deeply ingrained in culture-specific traditions which result in the use of different textual choices, rhetorical preferences and intellectual styles. Non-native English-speaking scholars tend to consider the Western rhetoric conventions in English a model to follow when they have, wish or want to disseminate new research knowledge. But in doing so, as illustrated in Chapter 4 and evinced by CR research, they retain the recurring lexicogrammar and rhetorical preferences of their L1 when communicating in English as an additional language. In this respect, varying linguistic manifestations of authorial persona have been reported on the use of first person pronouns and self-mentions (cf., e.g. Lorés-Sanz et al. 2010). Culture-specific rhetorical variability has also been reported in the use of attitudinal lexis (Shaw 2003), textual metadiscourse expressions (Crismore 1989, Mauranen 1993a, b, Árvay and Tankó 2004, Dahl 2004), as well as in the use of hedges, modals and epistemic modal markers (Ventola and Mauranen 1991, Markkanen and Schröder 1997, Vold 2006, Yakhontova 2006, Vázquez and Giner 2009). All these studies lend evidence to the fact that non-native English-speaking scholars tend to prefer different linguistic and rhetorical resources to those used by Anglophone writers when writing up research in English. As an emerging and controversial subject in the current linguistic and rhetorical debate, it is then apposite to define and understand hybridization, that is, glocal discourses, as an observable phenomenon in contemporary scientific rhetoric.

Mauranen et al. (2010a) describe the phenomenon of discursive hybridity in L2 English scientific texts as sharing 'homogeneity' traits (i.e. the use of the standard scientific English conventions) and 'heterogeneity' traits (i.e. the use of specific discourse practices and intellectual style of a given culture). The fact that texts hence become hybrid discoursal constructs is certainly complex and in need of in-depth investigation, as it is difficult to measure and generalize the extent to which a given text gets closer to the standard native English features (i.e. it becomes nativized or Englishized) and the extent to which it borrows L1 features that make it deviate from the standard model (i.e. it becomes hybridized). Further, it can be argued that the hybridization phenomenon is 'a means of reassuring the multicultural forces [. . .] that are actively participating in worldwide scientific exchange' (Mauranen et al. 2010a, p. 646), both in the written and the spoken modes of communication.

The merging of the Anglophone-based standardized rhetorical norms and local traits indicates that English in today's scientific interaction displays the features of 'negotiability, variability in terms of speaker proficiency and openness to an integration of forms of other languages' (House 2003, p. 557). The

process of discoursal nativization of English is seen by Berns (1995, p. 6) as 'evident in written texts which use English lexis and syntax, but maintain conventions of the native language and culture (e.g. rhetorical pattern, argument structure or coherence markers) for the composition of the text'.

For Kubota (2002, p. 13) globalization involves not only 'cultural homogenization influenced by global standardization of economic activities and a flow of cultural goods from the centre to the periphery' but also 'increased local diversity influenced by human contact across cultural boundaries as well as speedy exchange of commodities and information'. This view sensibly counteracts, for instance, Hamel's observations on the way globalization, in his view, is increasingly diluting the distinction between the national and the international sphere and is dissolving nation-states altogether (Hardt and Negri 2000). In the domain of scientific research, it can be ascertained that the hybrid texts appropriate the established rhetorical practices of the global context (namely, the standard scientific English discourse) yet retain some recurrent discoursal and rhetorical features of their L1. In a broad sense, the spread of particular forms of cultures across transnational boundaries may instantiate, as also does Chapter 4 this volume, what Pennycook (2007, p. 6) defines as 'transcultural flows', that is, 'processes of borrowing, blending, remaking and returning', 'processes of alternative cultural production'.

One of the effects of the current transcultural flows taking place in scientific discourse is that long-standing dichotomies between the 'global' and the 'local' – or, as posited earlier, the 'native' vs 'non-native'– are less germane as they eventually merge bringing about a new conception of the contemporary scientific arena. Now, the local-global synergy results in the homogenization of Anglophone rhetoric and discourse, while it brings to the fore culture-specific diversity across non-Anglophone, plurilingual communities of scientists. As discussed in what follows, the rhetoric of globalization shapes contemporary scientific discourse.

Chapter 3

Problematizing the Rhetoric of Contemporary Science

Standardization Practices in Scientific Discourse

This chapter provides a conceptually based enquiry into scientific discourse in relation to the commodifying, marketized nature of scientific knowledge production and dissemination. It neither revises the basic tenets of scientific genres nor revisits them (cf. Burns and Coffin 2001, and Swales 2004 for a comprehensive approach to scientific genres). Rather, the chapter maps out the phraseological, organizational and rhetorical features that reflect such marketization. As a commodifying object, with both socio-economic and institutional values attached to it, scientific discourse reflects at a textual level the 'selling' of the science that it disseminates and, more specifically, how the use of English for science dissemination reflects rhetorical variation when we compare genres produced by scholars from an Anglophone and a non-Anglophone context. Understanding science discourse through the textual acrobatics aimed at selling it – namely, persuading and engaging with the readership – was already posited by Kuhn (1962, p. 200) in the early 1960s:

> To understand why science develops as it does, one need not unravel the details of biography and personality that lead each individual to a particular choice [. . .] What one must understand, however, is the manner in which a particular set of shared values interacts with the particular experiences shared by a community of specialists to ensure that most members of the group will ultimately find one set of arguments rather than another decisive. That process is persuasion.

Scientific discourse has been broadly described as an objective, factual discourse, always dependent on evidence. However, while the informative load occupies the largest part of its textual (either written or spoken) space, persuasive elements targeted at achieving credibility, recognition and the acceptance of the new knowledge claims seep into the discourse. If we are to examine the 'selling' of scientific research through discourse practices we should bear in mind Fairclough's (1992, p. 207) claim that 'we can conceive of commodification as the colonization of institutional orders of discourse, and more broadly

of the societal order of discourse, by discourse types associated with commodity production'.

The rationale behind contemporary scientific discourse lies in Bhatia's multi-level model for applied discourse analysis. This model integrates three levels of communication: the textual level, the discourse (or generic) level and the social level. The textual level involves the identification of recurrent linguistic elements in texts across cultures and languages. Bhatia's conception of discourses as situated genres, that is, the discourse level, presupposes that full utterances should be interpreted within the rhetorical organization framework that the texts display. The third level of analysis, the social level, approaches the interpretation of texts considering the social context in which texts are produced and received. Bhatia's model is a suitable theoretical framework for understanding contemporary scientific discourse since it foregrounds the intersection of the textual, discoursal and social dimensions of specialized discourses, as shown in Figure 3.1:

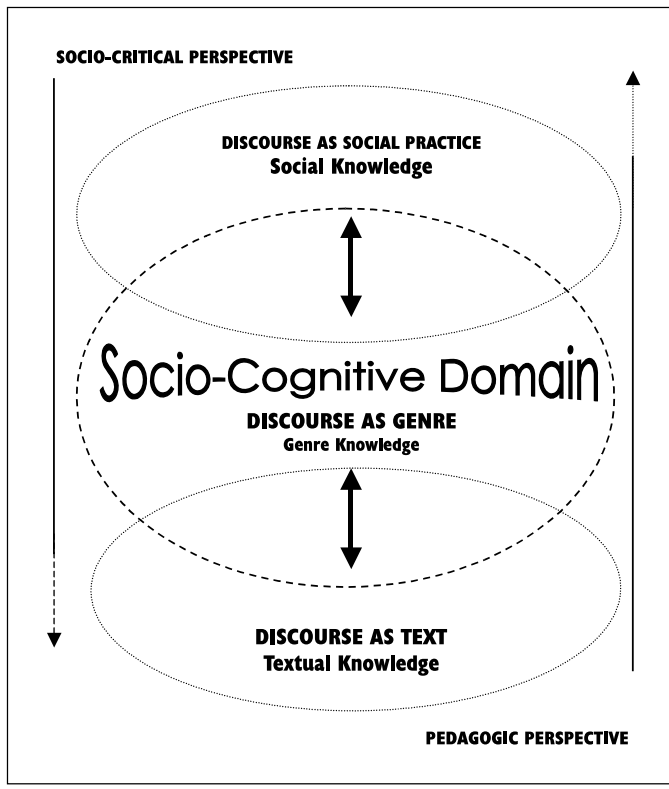

Figure 3.1 Bhatia's perspectives on discourse: three levels of communication (2002b, p. 16, cf. also 2002a)

Taking the socio-critical perspective, or a top-down approach, scientific discourse can be regarded as subject to institutional conventions as well as to the particular ethos of each sub-disciplinary field. It also shifts discoursally according to the specific discourse roles and privileges ascribed to writers/speakers and readers/listeners. This perspective provides an understanding of the discourse of science as an integral part of the socializing practices and procedures of the scientific community in general and local scientific research sites in particular. The scientific community, as a social entity, establishes certain genre and textual rules of interaction for an effective transmission of information among its members. Within this broadly defined, or 'large' scientific community, other small communities of practices – the so-called academic tribes – display well-defined rules of social interaction and particular research procedures and interactional practices.

Taking the pedagogical perspective, or a bottom-up approach, scientific discourse can be analysed at a textual level. At this level of analysis, the discourse of science shows a fair amount of uniformity and standardization in terms of lexicogrammar (also called in this volume phraseological) features across rhetorical sections but at the same time variegating lexicogrammatical preferences among writers/speakers from different cultural contexts and with different intellectual styles and scholarly traditions. Intertwining with the socio-cognitive domain, scientific discourse can further be conceived of as constructed upon well-established macro- and micro-level rhetorical patterns that help scientists organize information and build arguments when making new knowledge claims.

An all-encompassing view of scientific discourse subsuming the three levels of analysis is provided by Swales's (2007), metaphors of genre, to refer to the nature of genres as an intricate six-faced grid that encompasses guiding principles, conventional expectations, complex historicities, prototypes and variables, shaping contexts and directed discourses (see also Chapter 8 for a more detailed discussion). The first constituents of the grid, the guiding principles, are framed by the social actions in which genres are produced and interpreted. They are sets of language standards established by the discourse community that uses the given genres. These principles in turn determine the historicity of scientific genres within the community, the imitation-reinnovation synergy impinging on the family tree of the genres, the usage and exploitation of discoursal privileges and the different levels of writer/reader or speaker/listener interaction. This chapter, and the volume as a whole, concurs with this metaphorical nature of scientific discourse in academic and research settings since the six-faced grid neatly circumscribes the socio-rhetorical, discoursal and textual features of the discourse of science. As described later in Chapter 8, the grid allows an analytical view of the interaction between scientific discourse practices and conventional expectations on the one hand, and the shaping contexts and guiding principles that mould scientific discourse on the other

hand. It foregrounds differences across variables (e.g. disciplinarity, seniority and expertise, individual idiosyncrasies) both in the scientists' discourse processes and in the varying dialogic speech acts underpinning the written/spoken end-products (e.g. research articles, abstracts, conference presentations, etc.). Further, this all-encompassing view brings to the fore variations of promotional features depending on whether the science reported in the discourse aims to be 'sold' in a local, intranational context or in a transnational context of interaction.

Scientific Discourse and its Social Framing Context

A socio-rhetorical community is defined as the cultural basis for the development of community genres. Miller (1994, p. 73) explains that 'it is the community as invoked, represented, presupposed or developed in rhetorical discourse. It is constituted by attributions of characteristic joint rhetorical actions, genres of interaction, ways of getting things done' (see also Miller 1984, Gilbert and Mulkay 1984, Huckin 1991). Paraphrasing Hyon (1996, p. 696), this socio-rhetorical conception underpins the way scientific knowledge is produced, received and interpreted in response to 'networks of interpersonal relations that provide sociability, support, information and a social identity'. If we consider scientific discourse as a social practice, scientists' individual and/or collaborative research activities are materialized into written/spoken textual constructs. Through social practices, scientists elsewhere communicate their research outcomes within a given context of situation (i.e. their disciplinary community), a given context of culture (i.e. their cultural background) and the particular context of the genre (e.g. research articles, research monographs, conference presentations, academic talks). The disciplinary community shares disciplinary knowledge and genre knowledge. Disciplinary knowledge is concerned with what Kuhn (1962, p. 182) calls the 'disciplinary matrix': '"disciplinary" because it refers to the common possession of the practitioners of a particular discipline; and "matrix" because it is composed of ordered elements of various sorts, each requiring further specification'. In the case of scientific knowledge production, these ordered elements are, generally speaking, notions, symbolic generalizations and paradigms, theories and methods, specific natural facts and phenomena, as well as a particular research tradition for observation and experimentation. In turn, the genre knowledge determines the function and content of scientific discourse and 'establishes a universe of discourse which sets up imperatives for the language forms and structures' (Wilkinson 1991, p. xvii).

The 'framing context' (Bakhtin 1981, p. 343) of contemporary scientific discourse is of particular importance for understanding its dialogic nature, which

results from the institutional constraints, power and privileges. Gate-keeping and the construction of scientific truth have been approached from the perspective of the sociology of scientific knowledge (SSK). SSK regards science as a sociological and cultural activity whose policy involves accepting or rejecting knowledge claims by reference to the social context, not to objective enquiry into the factual world (Shapin 1995, 1996). From this viewpoint, the development of a scientific field is the result of 'identifying points of "contingency" or "interpretive flexibility", where at times, ambiguities are present' (Williams and Edge 1996, p. 869). This premise not only destabilizes the universality and credibility of disciplinary knowledge but also clearly points to issues of relativism of human knowledge and, by extension, of scientific knowledge (Skelton 1997, Pinch 1998, Gragson and Gragson 1998). Dialogic exchange in science communication further supports the idea that '[e]very discourse presupposes a special conception of the listener, of his apperceptive background and the degree of his responsiveness; it presupposes a specific distance' (Bakhtin 1981, p. 346).

Generally speaking, the scientific community is formed by researchers from different fields of enquiry. It creates and shares a network of social interaction, a kind of 'corporate enterprise' based on shared values, beliefs and epistemology. For effective communication, it relies on certain rules of solidarity and deference for social interaction. Peer-to-peer interaction in the dissemination and exchange of disciplinary knowledge is based on solidarity premises, and seeks to distance the scientific community from the lay community. On the other hand, rules of deference towards the established social orders and roles within the community involve awareness of possible confrontations of scientific knowledge. For example, the very cautious language with which Watson and Crick (1953, pp. 737–8) announced the discovery of DNA – 'It has not escaped our notice that the specific base pairing we have postulated immediately suggests a possible copying mechanism for the genetic material' – clearly reflects how discourse is tied up to the social context where new scientific knowledge is constructed, disseminated, interpreted and dialogized. As Hyland (2005, p. 11) rightly concludes, 'managing social relationships is crucial in writing because a text communicates effectively only when the writer has correctly assessed both the readers' resources for interpreting it and their likely response to it'.

Drawing on the tenets of sociological anthropology (Geertz 1983), scientific discourse operates at a transnational level as well as a national level for the purpose of knowledge dissemination at a gobal/local scale respectively. The broad framing context of scientific discourse can be ascribed both to the 'large' international scientific community and the different sub-communities of the varying disciplinary fields of knowledge. This community involves transnational communication worldwide. Concomitantly, contemporary scientific discourse takes place intranationally, that is to say, in small communities of

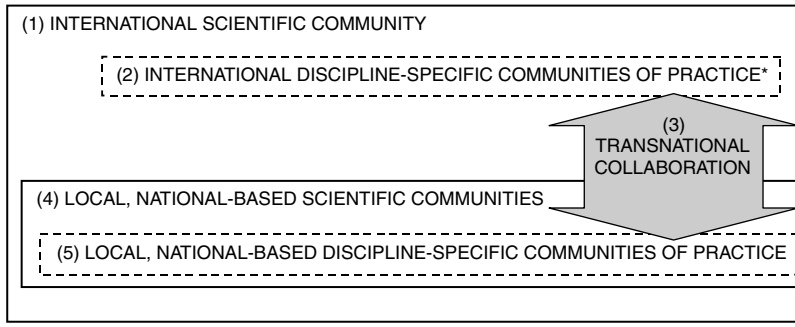

Figure 3.2 Proposed social framing context for scientific discourse

practice and local scholarly networks. The proposed social framing context for contemporary scientific discourse is shown in Figure 3.2.

In context (1), scientists address the wider community, that is the international scientific community. The new knowledge claims are of most concern for the wellness of society. This would be the case, for instance, of international, worldwide recognized publications like *Nature*, *Science* or *Cell*. In context (2), scientific discourse targets at international communities of practice in a given domain-specific field. Examples can be found in specialized international publications and specialized international conferences and seminars taking place worldwide. In context (3), knowledge dissemination often involves transnational collaboration across multidisciplinary research communities. For example, a number of journals invite interdisciplinary views of science, a form of communication which is currently experiencing an upward trend. Context (4) operates at a national, local level, and is the case of those journals that invite local practitioners and scientists to share research and act as major scientific exchange networks within the national territory. Apart from stimulating the exchange of results from local studies, scientists also include information on activities and conferences organized by each society. This scientific exchange is often funded by national-based scientific societies and associations, which organize specialized meetings, conferences and seminars on a regular basis. Finally, within context (5), the sub-disciplinary communities of practice also contribute to research dissemination and exchange among peer colleagues in the community. Exchange ranges from presentation of innovative research and new trends to small-scale case studies, experiments and practices in particular professional contexts. Publications are restricted to local, national-based journals which combine various sub-disciplinary fields. Cross-disciplinary research articles, popularizations and talks for a general audience approach the role of science to society in general.

These variegating framing contexts for scientific interaction involve varying degrees of institutional gate-keeping as well as different discourse practices in terms of discourse roles and privileges. They hence require specific ways for

addressing these different target audiences conveniently. At one end of the scale, the large community, as an elite community, evidently requires the highest level of deferentiality in scientific exchange. At the other end of the scale, more convivial positions are expected to be found, for instance, in publications addressing audiences of local practitioners. It is true that the deferentiality/solidarity cline conforms with the expected level of formality characteristic of the scientific register as opposed to, say, the style of other registers such as conversation, fiction writing or journalistic writing (Biber et al. 1999). Of note for the specific claims of the present volume is the fact that one of these constraints is language choice. It is precisely in the first three situational contexts that English is, to date, the lingua franca for knowledge dissemination and its presence seems to be expanding to other situational contexts. Reaching the wider audience has become a precious scholarly asset and, as a result, as sketched out in the previous chapter, local and national-level publications are shifting to publication in English in order to reach bigger audiences. As also explained later in this volume, other institutional and geopolitical reasons such as national academic rewards systems which confer greater recognition on international as opposed to national level publications or inclusion in national indexes for reasons of recognition affect the shift to English to the detriment of the local language, endangering peer-to-peer communication within national scientific communities and national sub-disciplinary communities (situational contexts (4) and (5)).

Devitt (2004, p. 31) explains that a '[g]enre is a reciprocal dynamic within which individuals' actions construct and are constructed by recurring context of situation, context of culture, and context of genres' (see also Gilbert and Mulkay 1984, Bazerman 1990, 1994, 1997, Dias et al. 1999). The above taxonomy of possible framing contexts for scientific dialogue neatly recalls Grabe and Kaplan's four parameters of audience (1996, pp. 207–11): type of audience reached, degree of proximity with readers, the relative status of the participants and the background knowledge. These parameters vary across the different contexts described above. At one end of the scale, scientific discourse published in internationally recognized journals, that is, those corresponding to context (1) reach the widest audience. These are followed by discourse types addressing homogeneous groups of specialists at a transnational level (corresponding to context (2)) and heterogeneous groups of specialists (context (3)).

Bearing in mind audience parameters, scientists establish closer proximity with their audience (generally known) when writing for national sub-disciplinary publications while they usually establish a greater distance when addressing peer colleagues transnationally and a much greater distance when publishing in top-tier/high impact-factor journals such as *Nature*, *Cell* and *Science*. This is so because these varying audiences share different background knowledge and hold different statuses (namely, prestigious worldwide recognized scholars vs novice scholars). It may also be the case that they belong to dominant vs peripheral cultural contexts. Only these social contexts thus

provide a comprehensive view of the 'archaeological unearthing of tacit assumptions, goals and purposes, as well as the revealing of unseen players and the unmasking of others' (Freedman and Medway 1994, p. 2). It is the actions of the community that shape scientific genres and it is those genres what community members need for constructing and disseminating new scientific knowledge.

The Socio-Cognitive Domain of the Rhetoric of Science

Bhatia's (2004, p. 20) view of discourse as genre 'extends the analysis beyond the textual product to incorporate context in a broader sense to account for not only the way the text is constructed, but also the way it is often interpreted, used and exploited'. Understanding the double-fold communicative purpose of scientific discourse claimed in the previous section – that is, the informative and the persuasive – lays suitable grounds for recognizing the generic conventions of the written/spoken discoursal manifestations of contemporary science within a socio-cognitive domain. This communicative rationale 'shapes the schematic structure of the discourse and influences and constrains choice of content and style' (Swales 1990, p. 58).

One of the overall constraints of scientific genres concerns the appropriateness of its overall style. Evoking William Strunk's (1918) recommendation to use an assertive tone avoiding non-committal language, and Barras's (1978, p. 33) advice on 'clarity, completeness, impartiality, order, accuracy, objectivity and simplicity', Gilbert and Mulkay (1984, p. 56) described the scientific style as predominantly objective, factual, with authorial involvement kept at a minimum:

> [. . .] overwhelmingly written in an impersonal style, with overt references to the authors' actions and judgments kept to the minimum. By adopting these kinds of linguistic features [impersonal features], authors construct texts in which the physical world seems regularly to speak and sometimes to act, for itself.

While this description generally applies to what at present shapes the written/spoken scientific register it nonetheless shows variation across genres, it is true that in both written/spoken genres today the ideational meaning intertwines with several interactive features that substantiate the Bakhtinian postulates on dialogism (Hyland 2000, 2005, Thompson 2001, Pérez-Llantada 2011). As argued earlier, one contributing reason to this stylistic shift is the fact that nowadays scientific production plays a key role in the global sphere and in knowledge-intensive economies. The dissemination of science was initially targeted at exchanging new knowledge among specialist peer-colleagues. At

present, it does maintain this goal but it also serves scholars worldwide gain greater visibility in a competitive research context. Another reason promoting the dialogic nature in scientific discourse in the global village is to be found in the changing nature of science itself and the 'increasing intellectual complexity' (Swales 1990, p. 115) derived from the increasing inter- and multidisciplinary, collaborative research in our days.

Constraints in the choice of content also display fixed rhetorical macro and micro-level information organization models in scientific discourse. By way of illustration, the standard research article follows a specific type of information patterning further classified by Gross (1990, p. 85) into two main patterns. The first pattern, followed by theoretical (or deductive) articles, provides a series of deductions and the conclusions imply the verification of previous observations. The second pattern, followed by experimental (or inductive) articles, includes 'a series of laboratory or field events leading to a general statement about natural kinds'. This broad categorization can likewise be extrapolated to the three most recurrent types of rhetorical macrostructures in current research article publications. First, roughly speaking, the argumentative essay consists of an introduction, a body and a conclusion. It is the common type of information organization in disciplinary fields tackling theoretical and abstract knowledge (i.e. the humanities fields, theoretical linguistics, art or history). Second, the IMRaD structure (Introduction, Materials/Methods, Results and Discussion) has become the prototypical organizational structure in experimental articles, for instance, in the biomedical and physical fields and in the fields of business and economics. Third, the problem-solution pattern comprises an introductory background, the statement of purpose, the solution provided by the authors and an evaluation of the solution. This third pattern prevails in applied sub-disciplinary fields of mechanical engineering, architecture, applied economics and econometrics, among others. Since the following chapter narrows down the enquiry into contemporary scientific discourse by looking at research article publications in a contrastive way, the three patterns are briefly described below.

In spite of its major role in the transmission of disciplinary knowledge in the fields of history, anthropology, cultural studies, theoretical linguistics or literature, among others, the argumentative essay has unfortunately not received as much as attention as, say, articles following the IMRaD pattern. This is possibly so because its scope is mainly restricted to the domain of the humanities (Roberts and Good 1993), either because the pace of publication is relatively slow or because the impact of the new knowledge on society is not so immediately valued as, for instance, that of the biomedical or technological disciplines. Argumentative essays are usually unsectioned articles. They provide an introduction with the theoretical framework of the study and a critical literature review. This is followed by a thesis statement and an indication of the analytical method(s) and a theoretical framework(s) used for the analysis of

texts. The body of the essay contains abundant exemplification, as well as citations from the source texts and intertextual references, and it is rich in causal argumentation. The Conclusion moves from the specifics of the study to the more general or abstract, that is, the broader theoretical context. This relatively flexible information organization may reflect the more abstract objects of enquiry, the deductive reasoning approach and the particular nature of knowledge of these (sub)-disciplinary fields.

The IMRaD pattern is also a predominant organizational format. Initially devised for the biomedical sciences, it is swiftly spreading to other disciplinary domains. Sollaci and Pereira (2004) report that this pattern started to be used in the 1940s in biomedical and health science publications and that '[i]n the 1970s, it reached 80 per cent and, in the 1980s, was the only pattern adopted in original papers'. Although these authors provide no reasons for the adoption of this format, they acknowledge that '[t]he IMRaD structure facilitates modular reading, because readers usually do not read in a linear way but browse in each section of the article, looking for specific information, which is normally found in pre-established areas of the paper'. This observation underlies the existence of readers' selective processes in scanning, skimming and, broadly speaking, processing information successfully.

One of the most evident examples of organization constraints is to be found the Uniform Requirements for Manuscripts Submitted to Biomedical Journals, also known as Vancouver Conventions. Endorsed by the International Committee of Medical Journal Editors, the Vancouver initiative was set up by a group of journal editors who, in 1978 agreed upon 'creating and distributing accurate, clear, easily accessible reports of biomedical studies' (<http://www.icmje.org/> 7 November 2010). These requirements rely on the IMRaD pattern and are used worldwide in order to 'publish articles that are timely, credible, and enjoyable to read' (Ringdal et al. 2009). In view of these requirements, scientists are expected to provide in the introduction of their texts a critical literature background against which the study is set and then state the purpose and relevance of the study. Methods sections should contain a detailed account of methodological procedures, instrumentation, analytical trials and data gathering. In Results sections authors are expected to report on findings and highlight the most significant ones on the basis of evidence. Discussion sections summarize the main findings and explain their significance both in themselves and in relation to other studies. Limitations as well as recommendations and implications for future research are also information elements included in this section. With a fair degree of variation, both hard and soft applied disciplines such as physics, biology, business, marketing, geography, earth sciences, applied linguistics or information science, to name but a few, stick to the IMRaD pattern conventions.

Along with the argumentative essay and the IMRaD article, a third major rhetorical macrostructure described in the literature is the so-called

problem-solution pattern. This pattern has been comprehensively approached by Hoey (1983, 2001), who defines it as a self-contained organizing pattern in written discourse. It is broadly used in scholarly genres such as construction and architecture textbooks (Orna-Montesinos 2012), professional engineering reports (L. Flowerdew 2008) and in student and professional technical writing (L. Flowerdew 2003). In the case of research articles, it is the domains that deal with heuristic, functionally oriented approaches that use this particular pattern. The pragmatic or utilitarian ethos of both hard and soft applied disciplines such as electrical and electronics engineering, fluid mechanics, computer science, education or clinical medicine, among others, rely on a problem-solution dynamic that at a textual level is reflected in the problem-solution pattern. The Situation-Problem-Solution-Evaluation embodied in this pattern likewise encourages writers to arrange the informational flow in semantically related sections. The Introduction contextualizes the study, describes the underlying theoretical framework and reviews previous studies that have approached the problem under investigation. This is followed by the statement of the problem to be investigated, a description of it, a definition of the variables of the study and the research hypotheses. The subsequent section is devoted to the solution of the problem, which provides a description of the method employed or the procedure(s) followed to solve the previously described problem. A final section provides an evaluation and interpretation of the proposed solution. Often, a brief concluding section states implications and limitations of the research presented, by this means paving the way for further lines of research enquiry in the field.

Overall, the three types of information organization constraints ultimately respond to the specific ethos and nature of knowledge of each particular disciplinary and sub-disciplinary field of scientific enquiry. Information organization norms in scientific discourse enhance the readability of texts and provide the audience with a better-organized flow of ideas which can be more quickly assimilated. These constraints are thus pertinent in so much as they consider readers' expectations of the kind of information they expect to find at a certain point in the text. Lack of adherence to the established ways of arranging information might be taken as a pitfall. Although the pitfall may not result in the rejection of the article for publication, it may none the less affect its readability and comprehensibility.

The Textual Features of Contemporary Scientific Discourse

In essence, the textual – hereafter specifically referred to as lexicogrammatical or phraseological – features of scientific discourse ought to be understood as intrinsically related to its social and cognitive (or genre) domains. Different rhetorical intentions are conveyed through a range of lexicogrammatical features

according to the particular framing context, communicative purpose(s) and type of audience of the given genre type. Textual embeddings of scientific knowledge are crucial for an understanding of 'how linguistic representations reveal and constrain conceptual representations and how conceptual representations are mapped into linguistic representations' (Tomlin 1997, p. 162).

Textual features allow scientists to make use of structural units in such a way that the information is conveyed appropriately. Scollon and Scollon's (1995, p. 98) 'C-B-S style', standing for clarity, brevity and sincerity in professional communication can likewise be applied to scientific communication. Clarity and conciseness in the transmission of information are strategic constituent elements of scientific discourse, both written and spoken. Understood in terms of economy of words, conciseness of expression involves using the exact information and to do so with precise words, avoiding vagueness of expression. In an increasingly competitive research world, getting across the maximum amount of information in the quickest way becomes a must. Conciseness and lack of verbosity in scientific discourse involve the use of highly lexicalized terms which are of course discipline-specific. These terms contribute to accuracy and truthfulness in reporting disciplinary knowledge and simultaneously fulfil a gate-keeping function in discourse. Being only accessible to peer-colleagues in the discipline, these terms are not part of the lexical repertoire of the lay readership nor, presumably, of members outside the particular sub-disciplinary field of research. They hence restrict the scope of the readership and in doing so instantiate the existence of well-defined academic tribes and confined circles of interaction for academic and research exchange.

Accompanying highly specialized scientific vocabulary, high frequency vocabulary items such as those compiled in the Academic Word List (Coxhead 2000) also play an important textual role in the construction and transmission of scientific knowledge. As seen in the following chapter, words such as *analyse*, *determine*, *define*, *study*, *results*, *principle* or *data* are high-frequency lexical constituents of scientific discourse (cf. also forthcoming chapter). These word families are not exactly specialized terminological terms but rather procedural words through which propositional content is conveyed. Formal definitions, physical and functional descriptions and classifications are constructed upon both specialized and procedural types of vocabulary (e.g. *as a function of the*, *the use of the*, *on the basis of the*, etc.). These structural units reinforce the reliability of transmitting knowledge based on empirical, experimental or argumentative facts. In addition, they facilitate confirmability, that is, the capacity to corroborate the truth value of the research reporting.

A concise transmission of information also draws upon the lexical density and syntactic construction in scientific discourse, indeed more noticeable in its written mode. Lexical density is regarded as a feature that restricts the accessibility of the semantic interpretation to those outside the specific disciplinary community. Nominal compounding, for instance, aims at simplifying long

strings of nouns and their modifiers (e.g. *measurements of contents of water according to the strength of a gravitational field*) in a single chain of noun compounds (e.g. *gravimetric water content measurements*). The gate-keeping function of lexical specificity in noun compounds works as follows. In a nominal compound the semantic relationship between the two nouns is not stated explicitly. While this involves writers' compressing of information for the sake of brevity, at the same time it requires the readers' disambiguation of the semantic connection between the nouns. High lexicality indicates that the text addresses a specialized audience with sufficient shared background knowledge so as to be able to decompress the semantic information appropriately.

A related textual process that favours both conciseness and cohesion in scientific texts is that of nominalization, defined as 'the process by which non-nominal structural elements are made to function as nominal elements' (Matthiessen 1995, p. 101). Through this grammatical process, a verb like *analyse* or *study* may, for instance, appear as a noun (*an analysis*, *a study*) in the forthcoming sentences/proposition, thus establishing a lexical linkage between the two sentences/propositions (cf. Quirk and Greenbaum 1978, pp. 20–1). Nominalization lies at the interface between lexical syntax and lexical semantics and helps scientists regulate informative density by placing emphasis on the new information. In addition to maintaining a cohesive flow of ideas, this process also confers greater rhetorical emphasis to what follows the nominalized action, following the theme/rheme principle. As illustrated in the following chapter, the shift from dynamic verbs to references to stative entities confers greater rhetorical emphasis to the propositional contents following the nominalized action and thus reinforces the structure of arguments establishing contingent constraints of interpretation to those readers outside the specific (sub)-disciplinary community.

In also targeting at clarity and conciseness in scientific reporting, several lexicogrammatical features in scientific texts help scientists construct propositional content and maximize the cognitive processing of the informational flow by avoiding ambiguity and obscurity of meaning. The existence of such lexicogrammatical scaffolding has been supported by EAP scholarly work arguing that in scientific discourse domain-specific academic vocabulary items do not occur in isolation but in collocational or phraseological patterns (cf. Hyland and Tse 2005, Hancioğlu et al. 2008, Durrant and Mathews-Aydınlı 2010). Biber et al. (1999, pp. 997–1025) identify eight different structural patterns in a list of most frequent 4-word bundles in academic books and research articles. These patterns (noun phrase + *of*, prepositional phrase + *of*, other noun and prepositional phrases, passives + prepositional phrase fragments, anticipatory *it* + verb/adjective and *be* + noun/adjectival phrase) recur in high-frequency grams such as *a large number of*, *the fact that the*, *as a result of*, *on the other hand*, *is defined as the*, *it is important to*, *it should be noted that* or *is due to the fact*. Along similar lines, Hyland (2008, p. 12) further explains that the most frequent

4-word bundles in research article writing (*on the other hand*, *in the case of*, *at the same time*, *as well as the*, *the results of the*) contribute 'to our sense of coherence in a text'. In addition, Hyland reports that these structural patterns recur across disciplines as varied as biology, electrical engineering, applied linguistics and business, which provides evidence of the phraseological nature of scientific prose. Chapter 4 also describes scientific written discourse as built upon standardized phraseological units across cultural contexts and languages. A standardized phraseological profile, though showing divergent linguistic preferences with those in the written mode, can also be traced in academic spoken discourse (cf. Simpson-Vlach and Ellis 2011).

Another textual feature in scientific discourse is the use of generic noun phrases. These are usually formed by an abstract noun as the head of the phrase (e.g. *a factor*, *a method*, *a study*, *an issue*, *a question*, etc.) and procedural vocabulary (e.g. *carry out an analysis*, *set/establish a hypothesis*, *draw conclusions*, etc.). These phrases are often accompanied by post-modifiers that restrict the semantic scope of the head noun and in doing so serve as the structural basis to convey their intended propositional meanings in a concise way. By way of illustration, recurrent lexicogrammatical units of move structures in scientific papers such as *in this paper*, *in the present study we* are typical for stating the communicative purposes in research article Introductions. Structural patterns such as *was used to* or *used in the* recur in Methods sections while *the results of the*, *the results of this* or *as shown in fig.* # are frequent in Results sections. Phraseological units such as *it should be noted that, it is important to* or *it is possible to* are more commonly found in Discussion/Conclusion sections (see Chapter 4 for illustration of these structural patterns).

Together with lexical cohesion, grammatical cohesion elements such as discourse markers are also important cohesion devices in scientific discourse as they help writers/speakers elaborate their arguments by establishing comparisons and contrasts, providing alternatives and exemplification, paraphrasing, etc. (e.g. *on the one hand*, *on the other hand*, *for example/instance*, *that is/that is to say*, *in addition*, *however*, *in other words*, etc.). At other times, they assist them in constructing arguments. This is the case, for instance, of *however* when creating a research niche (e.g. *however, nobody to date has attempted to explore x*), or *as a result*, *consequently* or *thus* in laying bare explicit reason/result argumentation at a textual level. Writers/speakers succeed in attaining an accurate representation of the research and its implications whenever they establish appropriate linkages of concepts and propositions. Discourse markers provide mappings for readers/listeners and facilitate their understanding of the relationship between topics and argumentative tactics. Essentially, they work as pre-revealing metadiscourse features of the writer/speaker's intentions: the enumeration of stages in a process, the exemplification of facts, reporting what others have said to introduce the topic under discussion, references to visual or non-linguistic elements or the recapitulation of previously

mentioned ideas (Salkie 1995, p. 75). Put succinctly, interpropositional connections through discourse markers act as explicit signposts in the written/spoken reporting of scientific research.

As stated above, cause-effect relationships conveyed by discourse markers such as *because*, *as*, *in order to*, *therefore*, *thus*, *consequently* or *as a result*, among others, establish neat interpropositional connections in the construction of argumentation. Tying reasons to results, causes to effects and means to ends guarantees sound argumentation. Clausal relationships link premise-conclusion propositions for the sake of assertion of the claims made by writers/speakers. At a discourse level, causal relations support explanations of research procedures and outcomes. Further, they allow the audience to envisage the validity of the claims made and the degree of scientific rigor with which the new scientific findings have been generated.

Anaphoric determiners/pronouns, particularly 'attended/unattended' *this* (Swales 2005) are another interesting cohesion feature in scientific discourse. These items link premises effectively to support claims and occur with a notable frequency of around 6 times per 1,000 words on average in academic writing. Swales explains that either as demonstrative pronouns ('unattended *this/that/these/those*') or as determiners followed by a noun phrase ('attended *this/that/these/those*') their rhetorical value is not so much their role as cohesion elements referring to previous noun phrases but rather as signposts of new information in a central clause position. 'Overwhelmingly refer[ring] to antecedents that are complete clauses (but not extended discourse that spans sentence boundaries)' (Gray 2010, p. 15), demonstratives follow the 'given/new' or 'topic/focus' principle for thematic progression and alert readers to the fact that what follows is new information. In such role, they can thus be seen as promotional resources implicitly performing a persuasive function in discourse (cf. Gosden 1992). Not by chance, grams embedding anaphoric pronouns/determiners such as *this is the/a*, *in this case*, *of this study*, *this type of*, *en este trabajo*, *de este modo*, *en/de este tipo*, etc. are high-frequency words in contemporary scientific reporting, as illustrated in the following chapter.

Performing analogous cohesion functions, anaphoric abstract nouns like *issue(s)*, *fact(s)*, *matter(s)*, *assumption(s)*, etc., together with shell nouns like *findings*, *results*, *problem(s)*, *question(s)* or *evidence* usually form collocational patterns with demonstratives and are highly procedural in nature. Abstract nouns are used either prospectively or retrospectively. Their main discourse function is to knit the argumentative flow minutely by encapsulating part of the informational load stated in previous propositions or by thematizing the new information given.

While the rough lexicogrammatical characterization described above is mainly targeted at conveying clarity and conciseness, several other lexicogrammatical resources explicitly target at establishing dialogism and seeking persuasion in scientific discourse. This lexicogrammar is rhetorical in the sense

that scientists are engaged 'with thinking about [their] reader's likely expectations and reactions, with deciding on what to say – and what not to say – about our data and with organizing our texts in ways that meet local conventions and yet create a space for ourselves' (Swales and Feak 1994, p. 3).

Scientists are normally members of several discourse sub-communities and hence address readers/listeners in a given way according to the particular framing context the transmission of information is ascribed to (see Figure 3.3). Generally speaking, addressors 'alter their norms for speech behaviour to conform to the appropriate speech community by adding, subtracting and substituting rules of communicative behaviour' (Fasold 1990, p. 42). In scientific discourse, different clines of authorial commitment to/detachment from claims can be found. Various theoretical frameworks such as metadiscourse (Vande Kopple 1985, Crismore 1989, Mauranen 1993a, Hyland 1998b, Ädel 2006, 2008, Ädel and Mauranen 2010), stance and engagement (Thompson 2001, Hyland 2005), evaluation (Hunston 1993, Hunston and Thompson 2000, Mauranen and Bondi 2003) and modality (Bybee and Fleischman 1995) coincide in that the choices among the variants of a linguistic variable are 'influenced by both social and linguistic forces' (Fasold 1990, p. 264), hence the existence of clines of commitment to/detachment from propositional meanings in scientific discourse across cultural contexts and across languages.

Constructing new knowledge involves using solidarity rules such as allowing the audience to participate, creating complicity or maintaining a hassle-free attitude. In the case of written discourse, Bazerman (1990, p. 78) remarks that 'the writing-up of results was more of an after-the-fact reconstruction to make one's results seem attractive, important and true to the consumers of knowledge'. Even if the transmission of scientific knowledge in an accurate and objective way is the primary target in scientific communication, scientists also seek and need to find the right tone for persuading their audience of the validity and significance of this new knowledge.

Following the Hallidayian School of Linguistics, Hyland's (1998b, 2005) broad or 'integrative' approach to metadiscourse distinguishes two types, textual and interpersonal metadiscourse. Textual metadiscourse comprises those 'devices which allow the recovery of the writer's intentions by explicitly establishing preferred interpretations of propositional meanings' (1998b, p. 442). Drawing upon Jakobson's (1975) functions of language, the metalinguistic, the expressive and the directive, the narrow or 'non-integrative' approach to metadiscourse, Mauranen (1993a) defines text-reflexivity as self-reflective linguistic material referring to the evolving text or to the writer and the imagined reader of that text. Referred to by Johns as 'pre-revealing features' or 'metamessages' (1997, pp. 120–2), textual metadiscourse material helps writers/speakers to use textual organization to alert readers to the functional and semantic connections between propositional material (see also the case

of academic speech, for example, Mauranen and Bondi 2003, Simpson 2004, Bondi 2007). Following Jakobson, the non-integrative approach to metadiscourse draws attention to the discourse functions of metadiscourse resources in three foci: the text/code, the writer and the reader (Ädel 2008, p. 44). Text/code expressions help scientists define domain-specific concepts (e.g. *A PSM was defined as [. . .], Haematuria is a known late complication*). Another set of metadiscourse expressions perform text-oriented functions in discourse. Through text-oriented metadiscourse expressions writers introduce topics (e.g. *in this study we*), announce informational focus (e.g. *the paper is organized as follows*, *the following section illustrates*), summarize and conclude (*in summary*, *to conclude*), remind readers of previous textual material, exemplify or indicate that new information is given (*the more recent work described above*, *for instance*, *in addition*). Clausal elaboration, reformulation and exemplification facilitate readers' interpretation of the information put forward in the text. In addition to clarifying informational content, these micro-level functions implicitly acknowledge an awareness of the intended readership. Of note, rhetorically prominent in scientific discourse is the micro-level discourse function of arguing, clearly underpinning a persuasive goal in research reporting.

Along with text-oriented metadiscourse resources, participant-oriented metadiscourse features are defined as those 'alert[ing] readers to the author's perspective towards both the propositional information and the readers themselves' and as such they are 'essentially interactional and evaluative' (Hyland 1998b, p. 443). These resources construct 'a stage-managed form of dialogue' (Thompson 2001, p. 58) and play a key role in 'creat[ing] and maintain[ing] a relationship' (Ädel 2008, p. 45). This can be done by anticipating readers' disagreement to what is said (*it is likely that*, *may be due to the*), clarifying textual material to avoid wrong interpretations (*in other words*, *that is*), presupposing readers' agreement with the claims made (*x can help us understand*) and appealing to them to share similar lines of thought (*it is important to*, *it should be noted that*). Importantly, metadiscourse units performing both text-oriented and participant-oriented functions should be seen holistically as they merge in the discourse to maximize clarity in the transmission of contents and strengthen the persuasive effects by establishing a dialogue with readers.

In peer-to-peer communication scientists engage with their audience through various interpersonal resources whose rhetorical effect is to enhance credibility, agreement or acceptance of claims. Interpersonal metadiscourse encompasses those rhetorical resources that scientists use for 'claiming solidarity with readers, evaluating their material and acknowledging alternative views, so that controlling the level of personality in a text becomes central to building a convincing argument' (Hyland 2005, p. 173). Through metadiscourse units scientists explicitly reflect in their texts that they seek to align with their peers for the sake of gaining acceptance of the claims made. For instance, phraseological grams such as *as can be seen* or *as shown in fig.* involve

an engagement manoeuvre since they specifically 'instruct the reader to perform a particular kind of action in relation to the text being read' (Swales et al. 1998). Commentaries (*if we compare it with some of the examples mentioned above*, etc.) allow the construction of an implicit dialogue with the audience. Conditional clauses, introduced by the high-frequency word *if*, likewise perform a wide range of discourse functions seeking engagement with readers, as noted by Warchał (2010, p. 140):

> [. . .] to guide the reader's interpretation while allowing for a certain degree of independence in reaching the conclusions, to engage the reader by leaving some questions open for further discussion, to negotiate terms and concepts, to ward off possible criticism, to signal problem areas, to acknowledge other points of view or potential threats to the cogency of argumentation and to involve the readers by directly soliciting their approval.

Also performing an interactional function in discourse, boosters comprise epistemic stance adverbs and certainty adverbials (e.g. *evidently*, *certainly*), evidential reporting verbs (e.g. *demonstrate*, *indicate*, *show*), certainty modals and semi-modals (*must*, *have to*) (e.g. Afros and Schryer 2009 with humanities papers, Vázquez and Giner 2009 with marketing, biology and mechanical engineering articles). Through attitude stance markers (e.g. *remarkably*, *interestingly*), emphatic adverbs (e.g. *clearly*, *indeed, of course*) and intensifiers (*extremely*, *very*, *totally*) scientists invite their peer audience to align with their views by appealing to common knowledge and shared understanding (cf. also Chapter 4 for a contrastive rhetoric comparison).

Rhetorically, anaphoric nouns – also mentioned above as a type of grammatical cohesion marker – also serve as textual signposts of writers' evaluative comments. These nouns tend to collocate with evaluative adjectival modifiers (e.g. *the main point*, *an essential fact*, *the key aspect*, etc.). Collocating with lexical words, scientists qualify noun phrases through evaluative descriptors (e.g. *significant*, *important*, *insufficient*, *critical*, etc.). In the case of research articles and abstracts, for instance, Introductions and Discussions are rich in explicit attributive adjectives (e.g. *a good coverage*, *an important role*, *an attractive idea*, *a fundamental component*) that evaluate previous research, emphasize ideas, assess or judge entities, objects and processes (see also Stotesbury 2003). In projecting their persona onto the discourse, scientists establish proximity relations with their audience while seeking consensus and acceptance of claims.

Anticipatory *it*-patterns and *that*-clauses are two syntactically elaborate constructions that contribute to persuading readers. Both recur in academic written and spoken genres and involve explicit evaluation of propositional contents (e.g. Hewings and Hewings 2001 in published journals and in undergraduate texts, T. Johns 2001 in *Nature* texts, Hyland and Tse 2005 in abstracts). In the former type of construction, the heavy constituents are placed at the end of the

clause (e.g. *it is assumed that*, *it is important to*, etc.). This pattern often collocates with epistemic lexical participles like *considered*, *believed*, *thought* or *suggested*, for the purpose of hedging claims. At other times, it collocates with evaluative adjectives (e.g. *significant*, *important*, *noticeable*, etc.) with which scientists qualify propositional contents. In *that*-complement clauses, heavier constituents are also placed at the end of the clause following the end-weight principle. As extraposed subjects, these constituents introduce the new information. By placing them at the end of the clause, attention is drawn to the new information. Though seemingly impersonal constructions, recurring *that*-complement clauses connect evidential results, data or analyses with conclusions (T. Johns 2001, p. 56). Making this connection explicit reduces the expression of uncertainty to a great extent and at the same time foregrounds the validity of the claims made.

Other textual elements like intertextual references (in the form of integral and non-integral citations), statements of attribution (e.g. *according to x*, *following x*, *from the perspective of*) and self-citations are key promotional features in scientific discourse (Hyland 2001, Hyland and Hamp-Lyons 2002, Harwood 2005a, b). From a socio-critical perspective, Briggs and Bauman (1992, p. 132) ascertain the 'textual open-endedness' of scholarly genres by understanding intertextuality as a prototypical feature of these genres and further argue that 'grasping the complex intertextual relations that underlie genre, along with the way these relations are closely linked to social, cultural, ideological and political-economic factors'. Rhetorically, citations situate the research in the disciplinary domain, indicate familiarity with the relevant literature on the topic being investigating and an active role in the field of research. As reported in this volume, citation and attribution ascribe relevance to previous literature and support the assertions made in the discourse, with no attested differences across cultural contexts and languages.

The concept of factual evidence is fundamental in understanding scientific discourse and takes it for granted that the reporting of results draws upon the application of the scientific method, experimentation or argumentation. It has been convincingly argued that meeting audiences' needs and expectations requires a certain degree of deferentiality towards the particular disciplinary community of peers. Recurring frequently in scientific writing, hedging resources reduce the level of certainty and convey vagueness in such a way that facts are no longer imposed but suggested to the scientific community. Hedges 'show that the speaker/writer is conscious of the quality maxim' (Yule 1996, p. 38) and display explicit social functions that reflect how 'academic writing takes place within social institutions that require negotiation of complex boundaries: between departments, between disciplines, between academic and applied roles, between academic and popular audiences' (Myers 1996, p. 3). By anticipating readers' reactions, scientists hedge their discourse and hence show awareness of scientific speculation and the provisional nature of

scientific knowledge. Put succinctly, hedges and, broadly speaking, the rhetoric of understatement 'regulate both the acceptance of claims and admittance into the "inner circles" of the community' (Dressen 2003, p. 274).

The use of the passive voice is also a recurring feature that favours authorial detachment in scientific discourse. Passives constructions such as *x was used*, *x was based* or *x was obtained* ascribe greater emphasis to the research topic/field than to the researchers themselves, hence contributing to impersonal, drawn-upon-facts reporting of research outcomes. For Myers (1996, p. 4), passives blur the identity of the author and foreground the universality of science leaving aside individual landmarks. Passivization, more recurrent in the written than in the spoken mode, performs the following discourse functions: to indicate an established procedure, to describe others' work or the author's proposed studies or to emphasize depending on sentence-length (Tarone et al. 1981, Riley 1991). But even this objectivity-oriented grammatical feature further involves a persuasive function in discourse. Martínez (2001, p. 228) notes that in spite of its apparent absence of rhetoric, passivized reporting of scientific processes and outcomes 'may reveal the tension between the writers' need to distance themselves from the text to present findings objectively and the need to approximate to it in the appropriate style in order to persuade readers of their validity'.

In both the written and the spoken mode, scientists modulate their degree of commitment to/detachment from claims. With reported variation across discourse modes and genres, disciplines and even languages and cultural contexts, epistemic modality markers expressing uncertainty include epistemic expressions (e.g. *somehow*, *to some extent*, *to our knowledge*), probability adjectives and adverbs (e.g. *perhaps*, *maybe*, *probably*, *likely*), probability modals (*may*, *might*, *would*) and epistemic lexical verbs (e.g. *believe*, *suppose*, *assume*, *suggest*, etc.). Authors use these markers to mitigate opinions in relation to the truth value of propositions (cf. Salager-Meyer 1994, 2000, Skelton 1997, Hyland 1998a, Varttala 1999, Rezzano 2004, Vold 2006, Pérez-Llantada 2010b). Mitigation of claims facilitates a non-assertive rendering of information and brings to the fore the necessary audience awareness in the construction of appropriate dialogism in terms of their background knowledge (specialist to non-specialist communication), expectations (i.e. the readers/speakers' preconceived assumptions and response) and the institutional norms (i.e. when the interaction involves different discursive roles and statuses).

Mapping Intercultural Spaces in Scientific Discourse

The textual features described above should be taken as rough generalizations reported by the EAP literature on the nature of scientific discourse. Space constraints do not allow an in-depth discussion of the phraseological and

rhetorical specificities of the written vs the spoken discourse modes. That said, it should be noted that put together, the various rhetorical resources of scientific discourse described above generally comply with a set of established rules both for constructing discourse and communicating new knowledge across the different framing contexts for scientific interaction. At this juncture, both language and culture issues come to the fore. But before any textual analysis of scientific discourse (both in the written and the spoken mode) as it evolves in Anglophone (native English-speaking) and non-Anglophone (non-native English-speaking) research sites across different cultures and languages in the global village, it is necessary to have a unified view of this specialized discourse as a process and an end-product. The conceptual map (c-map hereafter) proposed in Figure 3.3 provides this unified view. It interrelates key concepts and underpins those theoretical frameworks and scholarly traditions that have addressed the discourse of science empirically and experimentally. The c-map allows navigation across key concepts of discoursal practices and processes in the construction and eventual dissemination of scientific knowledge through textual end-products. These concepts are equally valid for scientific production across cultural contexts and languages. Basically, the map brings to the fore four intersecting paths: (i) the actual dynamics of the process of gestating and developing new scientific knowledge, (ii) the textualization of such knowledge through words, (iii) the macro-organization of knowledge for effective transmission of knowledge and (iv) the contextualization of such knowledge within its social framing context.

The first path takes into consideration the dynamics involved in the process of constructing scientific knowledge and scientific discourse, this dynamics being subsumed under the labels 'research moment' and 'composing moment'. The second path reflects the textualization processes of scientific knowledge production, that is, the way scientific knowledge becomes text and text begets or produces knowledge. The third path reflects a higher level than the textualization process in so much as it frames the latter within a cognitively effective discourse organizing pattern. Finally, the fourth path relates the rhetoric of the genres to the social context where it is produced and interpreted by focusing on possible types of community interaction on the one hand and on the various ways through which the sociology of scientific knowledge shapes scientific discourse on the other hand.

The left-hand side of the c-map focuses on the dynamics of scientific written/spoken discourse. Such dynamics involves the gestation process of the final textual product (e.g. reading the literature, thinking critically, finding an inconsistency or a gap and finally applying the scientific method, as proposed by Barras 1978, p. 48). All these actions are part of the research moment, or the moment in which new knowledge is gestated. Understood as a process, the dynamics of scientific discourse also involves the actual moment of composing the text. This moment involves the reporting of findings accurately and

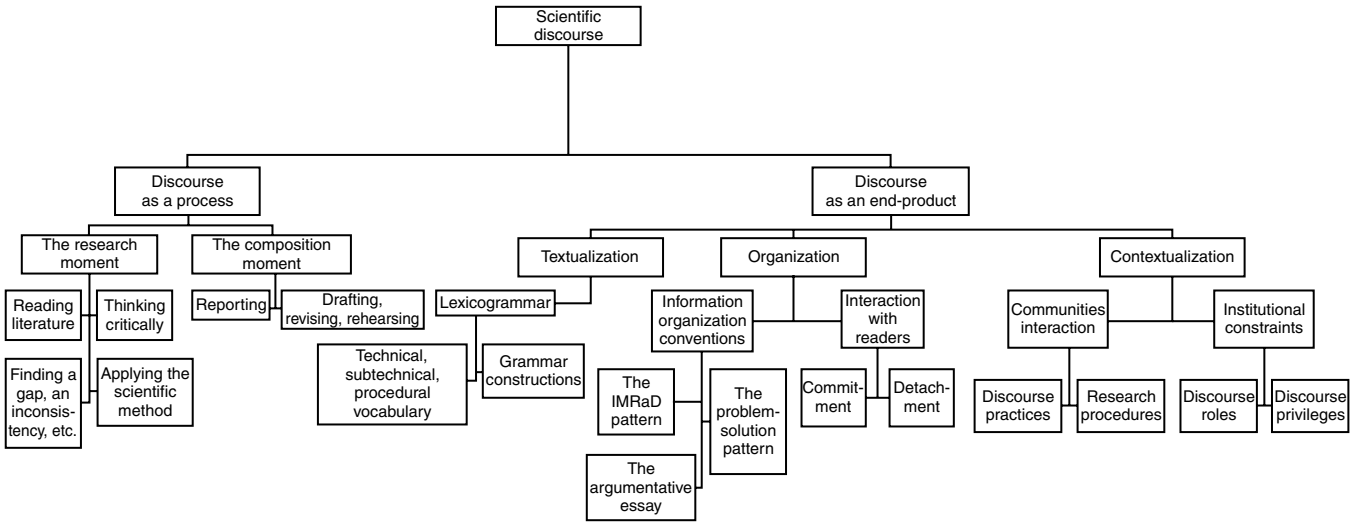

Figure 3.3 A proposed conceptualization of scientific discourse

objectively and at the same time convincing the audience of the validity of those findings. Drafting and revising (either done by the authors themselves or by language revisers or translators) are also part of the composing moment and further relate written genres with other minor – also called 'occluded' or 'interstitial' – genres. By way of illustration, a research article in its editorial process involves preparing the title page and author page, preparing an abstract, writing a submission letter and, if the paper is accepted, a resubmission letter to the editor specifying that it has been revised following the reviewers' recommendations. In the case of spoken genres, say, the conference paper presentation, interstitial genres would be a written draft or notes, a slide presentation and, after the presentation, the interaction with peers in the time allotted for questions.

The right-hand side of the map regards scientific discourse as a product which in turn comprises the interrelated processes of textualization, organization and contextualization of scientific knowledge. Textualization refers to the act of turning knowledge into words using both the recurrent lexical and semantic domains and the phraseological resources described in a previous section of this chapter. Propositional contents are textualized semantically through general, procedural and domain-specific terminology of the disciplinary domain. Alongside domain-specific vocabulary, recurring lexicogrammatical patterns characterize the phraseology of speech/writing described above.

The textualization of propositional contents and the setting up of semantic relations across propositions follow regularities in terms of information organization patterns. As stated above, these structural patterns are established by the disciplinary communities in relatively standardized ways, depending on whether the discourse is empirical or experimental in nature, or whether it is developed by either a descriptive, narrative or expository modality. These organizing patterns are part of the socio-cognitive domain of scientific discourse: the textual end-product is first rendered and later interpreted by the specific target audience of peer colleagues since the latter are expected to share not only assumed knowledge of the disciplinary field of enquiry but also academic literacy skills.

Interaction with peer colleagues allows scientists to engage with their audiences and draw them along similar lines of thought for rhetorical purposes. The fourth intersecting path of the c-map, that of contextualization, relies on the tenets of pragmatic politeness for reporting scientific facts and interacting with peers. The various clines of formality depend on the particular framing context in which interaction takes place – hence the variation from peer-to-peer communication in transnational communication vs peer-to-peer communication in intranational communication, for instance. Clines of formality also vary depending on the established institutional gate-keeping and social rules for interaction. The written and the spoken modes of scientific discourse,

for instance, rely on the construction of discourse roles and discoursal privileges within a given community of interaction. Broadly speaking, several factors determine the appropriate level of formality: the status of the scientist and his/her academic recognition within the field of enquiry, the nature of the target audience (national vs international, disciplinary vs sub-disciplinary) and the actual medium (knowledge dissemination in a high impact printed journal usually requires a higher level of formality than in a form of spoken interaction like a conference presentation).

All in all, the c-map describes scientific discourse as a context-sensitive construct for the 'manufacture of scientific knowledge' (Knorr-Cetina 1981) that encompasses different ways of reporting facts, facilitating effective transmission/interpretation of the information and conveying commitment to/detachment from the propositional meanings for various rhetorical purposes. Drawing on the theoretical tenets of the New Rhetoric School (Huckin 1991, Miller 1994, Berkenkotter and Huckin 1995), the c-map is sustained upon complementary theoretical frameworks such as rhetoric and composition, genre analysis, metadiscourse, reader-response criticism, the sociology of scientific knowledge and socio-constructivist views of disciplinary discourses. The c-map concepts are fundamental in the forthcoming chapters, which will address convergences and divergences across these general discoursal routines of scientists across Anglophone and non-Anglophone contexts.

Having made these generalizations on the discourse of science, it is worth pointing out that the socio-critical and the pedagogical perspectives to the analysis of scientific discourse discussed at the beginning of this chapter open up some further areas of linguistic and rhetorical enquiry. Both perspectives provide an understanding of the various ways contemporary scientific discourse is subject to the globalizing trends of the contemporary landscape. Precisely the complexity of these trends deems it necessary an enquiry into the cross-cultural and cross-linguistic specificities of scientific discourse.

From what has been discussed in this chapter, it can be concluded that the primary shaping force of scientific discourse is that it is built 'within a frame of social action' (Bhatia 1993, p. 13) and, as such, is a highly context-sensitive construct. The transfer of disciplinary knowledge across intranational and transnational frontiers takes place within small research communities that want or need to make their research visible in the international sphere, be recognized by the expert disciplinary community and/or conduct collaborative research. In order to understand the construction of intercultural spaces in scientific communication the above introspection into the socio-critical and the pedagogical perspectives proposed by Bhatia (2002a, b) anticipates in a sense Connor's (2008, p. 307) mapping of multidimensional aspects of disciplinary discourses. Drawing on the theoretical foundations of contrastive rhetoric, Connor (2008, pp. 14–15) circumscribes this multidimensional mapping as follows:

> The first map considers writing as a socially constructed activity and suggests that the study of writing should not be limited to texts but should consider the social practices surrounding it. The second map considers 'small' cultures and draws attention to the important roles of disciplinary and other such small cultures. The third map introduces the study of writing as an intercultural encounter where writers are interacting in the production and comprehension of texts.

The multilayered, evolving, competitive and highly dialectical nature of contemporary scientific discourse calls for textual and ethnographic-evidence as it requires an in-depth exploration of the actual linguistic and rhetorical practices of transnational scientific communication in the global village. Using corpus linguistics and ethnographic methods, the following chapters are devoted to mapping differences and similarities across scholars in Anglophone and non-Anglophone contexts regarding the linguistic resources, rhetorical traditions and community practices and procedures for interaction in their local research sites.

Chapter 4

A Contrastive Rhetoric Approach to Science Dissemination

Knowledge Construction and Dissemination: Tracing Convergence and Divergence

This chapter situates the study of scientific discourse in the current contrastive rhetoric approach. The view of cultural models as guiding our language and interactions with others is the underlying rationale of the chapter (cf. Gee 1996, 1999). Tracing cultural models and comparing convergences and divergences across cultural models make it advisable to use complementary theoretical frameworks, as also purported by Connor (2011, p. 11):

> [. . .] theories of rhetoric (writing as communication and persuasion is affected by audience), text linguistics (texts and writing have systematic, analyzable variation), genre analysis (writing is task and situation based and results in discourse types), literacy (the activity of writing is embedded in culture).

In combining these theoretical frameworks, the goal of this chapter is to observe how textual exemplars of contemporary scientific production are constructed and, more specifically, how scientists across cultural contexts textualize new scientific knowledge in adapting their discourse to textual conventions, socio-cognitive and social constraints. In agreement with contrastive rhetoric research (Kaplan 1966, Connor et al. 2008), it was initially hypothesized that textualizing knowledge across cultures was going to display two types of conventions, 'those common to the academic community and those held in esteem in the writer's national culture' (Mauranen 1992, p. 239).

Inspired by the contrastive rhetoric approach conducted by European scholars such as those involved in the KIAP project, *Cultural Identity in Academic Prose* at the University of Bergen (Breivega et al. 2002, Fløttum 2005), the creation of CADIS, a *Corpus of Academic Discourse* at the University

of Bergamo (Gotti 2006) or the ELFA project, *English as a Lingua Franca in Academic Settings*, at the University of Tampere (Mauranen 2011), the InterLAE research group at the University of Zaragoza completed in 2008 the compilation of SERAC 1.0, the *Spanish English Research Article Corpus*. The rationale underpinning the corpus construction was to study expressions of authorial evaluation in disciplinary texts across two cultural contexts. SERAC 1.0 comprised a total of 558 research articles published in scholarly journals. This first version of the corpus represented four major academic divisions: Humanities and Arts, Social Sciences and Education, Physical Sciences and Engineering, Biological and Health Sciences. Each academic division covered in turn two sub-disciplinary fields. SERAC initially comprised a subset of L1 English research articles and a subset of L2 English research articles (written in English by Anglophone and Spanish scholars respectively) for intercultural comparison. These two subsets of texts were comparable according to Moreno's (2008, p. 34) dependent or 'confounding' variables for *tertium comparationis*: similar text exemplars of scientific exposition, a formal situational variety and similar participants (scholarly writers/readers). An additional subset of articles written by Spanish scholars in Spanish and published in national-based (Spanish) journals was also compiled for interlinguistic research, that is, to taxonomize L1 Spanish features in scholarly writing and to identify the extent to which these features are transferred to the L2 English texts.

As explained in Pérez-Llantada (2008), the comparison of L1 and L2 English texts deemed it necessary to guarantee two main dependent variables: the language (English) and the type of audience (an international readership). Other factors affecting the production of texts were also taken into consideration in the corpus design. First, the year of publication of the texts was representative of twenty-first-century scientific discourse. Second, a selection of three impact-factor English-medium journals per sub-discipline – the same three journals for the compilation of the L1 and L2 English subcorpora – was expected to guarantee likely audiences, similar publication impact, a similar peer review system and editorial gate-keeping. The InterLAE group also decided that all the writers ought to have a university affiliation so that both those of the Anglophone-based context and the Spanish context were equally knowledgeable of the institutional background and the social reasons involved in publishing research both nationally and transnationally. InterLAE validated the texts written by the non-Anglophone scholars ensuring that these had not gone through language revisers' or English-native speakers' hands. Lack of responses on the part of the article writers might bias the corpus data but exploratory research with SERAC revealed noticeable similarities and differences in the writing practices of Anglophone and Spanish scholars regarding the use of linguistic markers of authorial evaluation. The analysis of a range of linguistic items, for example, person pronouns, self-mentions, metadiscourse expressions, modal markers

and other linguistic items of authorial stance yielded a fair amount of divergent discoursal functionality, disciplinary variation, cross-cultural variation across rhetorical sections, as well as lexical and discoursal differences in the construction of writer/reader interaction (full references available at InterLAE's website <http://www.interlae.com/>).

Valuing the potential of SERAC for both contrastive research as well as for pedagogical purposes, InterLAE decided to develop a larger-size corpus with the aim of gaining a wider description and characterization of research article writing in the two cultural contexts and in the two languages. To our knowledge, SERAC 2.0 is to date the largest contrastive research article corpus. Maintaining its initial design, SERAC version 2.0 contains 1,056 texts, and approximately 5.7 million words. It represents 12 different sub-disciplinary areas across the four academic divisions: applied linguistics, information science, literature, sociology, business management, geography, urology, haematology, oncology, mechanical engineering, food technology and earth sciences. A note should be made on the smaller number of texts of the Sociology subset of texts in the L2 English subset. In tracking comparable texts, the compilation of the L2 English texts revealed that in some disciplinary domains, as was the case of sociology, publication in English-medium journals was not common. However, the sub-disciplinary field was not discarded since it was considered to be a finding in itself in the comparison of scientific discourse practices across cultural contexts.

Corpus data was first processed with free software *kfN-gram* (Fletcher 2002–7) in order to retrieve lists of high-frequency n-grams and identify the recurring phraseology. *Wordsmith Tools* v.5 (Scott 2008) was used to retrieve overall statistics and to compute tokens (running words) and types (the number of distinct words in each subset of texts). Type/token ratios (TTR) and the standardized type/token ratio (STTR) (computed every 1,000 running words) were also used to determine the lexical profile of the texts. These procedures allowed the identification of the quantity of lexical or content words (i.e. nouns, lexical verbs, adjectives and adverbs) and the lexical density of each subset of texts. *Wordsmith Tools* was also used to retrieve concordance lines, clusters of n-grams, dispersion plot information and contextualized examples. Log-likelihood values and chi-square statistics were used to track statistical differences. Complementing corpus analytical methods, context- and genre-based analysis of the texts was used to identify the primary discourse functions of the high-frequency grams.

For obvious reasons of space, what follows is a very broad radiography of the main convergent and divergent features of the three subsets of texts (L1 English, L2 English and L1 Spanish). Considering the amount of data retrieved from a large-size corpus like SERAC 2.0, what follows is therefore an exploratory, primarily descriptive account of the phraseological, discoursal and rhetorical profile of the texts.

The Role of Standardized Lexicogrammar in Scientific Dissemination

Taking as a starting point the fact that scientific writing is a conscious decision-making process that involves a strategic use of linguistic and rhetorical devices, this section provides an overview of the lexicogrammatical (phraseological) profile of scientific discourse across two cultural contexts (L1 English and L2 English) and two languages (English and Spanish) to later illustrate similarities and differences in the overall discoursal and rhetorical embedding of scientific ideas and the functional motivations behind such embedding.

As shown in Table 4.1, the overall comparison of lexical density across subcorpora shows that there is not much variation regarding the information load across the two cultural contexts and the two languages. The TTR, which measures the lexical variety within a set of texts, is very homogeneous and only shows slightly greater density in L1 Spanish than in the L1 and L2 English subcorpora. Quantitative data also indicates that the information load is distributed differently regarding causal construction. The L1 English subset scores the lowest mean in words per sentence while the L1 Spanish subset scores the highest mean in words. The L2 English subset scores a mean which stands right between that of the L1 English and L1 Spanish both in terms of TTR, standardized TTR, TTR standard deviation, mean in words per sentence and standard deviation of mean in word per sentence.

Across academic divisions fairly similar TTR ranges and STTR ranges indicate fairly homogeneous ranges of lexical diversity (also called lexical variation or lexical variety). TTR in the L1 English subcorpus ranges from 3.34 in social sciences to 5.07 in biological sciences and from 3.98 in social sciences to 4.79 in biological sciences in the L2 English subset of texts. Both subcorpora score lowest TTRs in the social sciences division and highest in biological

Table 4.1 Overall statistics and lexical profile of SERAC 2.0 across subcorpora

	L1 English	**L2 English**	**L1 Spanish**
tokens (running words) in text	2 146 347	1 771 727	1 811 071
types (distinct words)	54 184	51 020	70 190
type/token ratio TTR	2.65	3.04	4.03
standardized TTR	37.44	37.7	39.21
standardized TTR std.dev.	62.42	62.75	61.40
sentences	87 390	66 903	60 085
mean (in words)	23.36	25.12	29.01
std.dev.	15.13	16.01	19.15

sciences. STTR in L1 English ranges from 34.38 in the physical sciences and engineering to 40.01 in the humanities and from 35.23 in biological sciences to 40.34 in the humanities in the L2 English subset. TTR in L1 Spanish ranges from 5.02 in the social sciences division to 7.12 in biological sciences. STTR in L1 Spanish ranges from 36.21 in biological sciences to 41.96 in humanities. As also happened in the comparable L1 and L2 English subcorpora, STTR scored highest in the humanities, indicating that in the two cultural contexts and in the two languages writers tend to display greater lexical diversity in this academic division. The distribution of informational load in terms of sentence length also shows disciplinary variation, with physical sciences scoring the lowest mean in words and standard deviation in both L1 and L2 English. In the L1 Spanish subcorpus it is the biological sciences that score lowest and social sciences highest in terms of sentence length. See Table 4.2 and Table 4.3.

Lexical resemblance can also be observed in the use of high-frequency words in the three subcorpora. Non-lemmatized frequency lists of the three SERAC subsets were retrieved with *Wordsmith Tools* and compared with the top-100 word frequency list (not lemmatized) of a 100 million word corpus, the *British National Corpus of Written and Spoken English* (BNC) (cf. Leech et al. 2001, p. 120). The comparison of the four frequency lists shows that lexical density is higher in the three subsets of SERAC than in the BNC, hence confirming the specialized profile of SERAC, as explained below.

In contrast to the general lexical (content) words of the BNC, of the lexical (content) words of SERAC, a number of domain-specific, also genre-specific

Table 4.2 Overall statistics and lexical profile of L1 English and L2 English across academic divisions

	L1 English				**L2 English**			
	BIO	**HUM**	**PHYS**	**SOC**	**BIO**	**HUM**	**PHY**	**SOC**
tokens	309 577	692 378	417 815	726 577	302 067	641 428	402 896	425 336
types	14 420	28 582	18 790	23 287	13 114	29 396	17 750	16 176
type/token ratio TTR	5.07	4.26	4.83	3.34	4.79	4.73	4.69	3.98
standardized TTR	35.19	40.01	34.38	37.56	35.23	40.34	35.32	37.47
standardized TTR std.dev.	64.42	57.75	63.37	62.79	63.89	61.82	62.82	61.62
sentences	11 141	27 890	20 273	28 086	10 534	23 829	16 201	16 339
mean (in words)	25.52	24.08	19.19	24.79	25.99	26.11	23.35	24.9
std.dev.	15.71	16.75	13.18	13.92	20.77	18.45	13.43	13.78

Table 4.3 Overall statistics and lexical profile of L1 Spanish across academic divisions

	L1 Spanish			
	BIO	**HUM**	**PHY**	**SOC**
tokens	249 320	612 756	331 827	617 168
types	16 553	40 723	20 499	30 079
type/token ratio TTR	7.12	6.87	6.45	5.02
standardized TTR	36.21	41.96	36.56	38.89
standardized TTR std.dev.	63.67	59.95	62.79	61.99
sentences	8 602	21 090	11 242	19 151
mean (in words)	27.03	28.13	28.28	31.29
std.dev.	16.31	21.72	16.09	18.76

words recur in the three specialized subcorpora. Content words like *data/datos*, *study/estudio*, *work/trabajo*, *analysis/análisis*, *research*, *information/información* and *results/resultados*, for instance, indicate that the three subcorpora represent a highly informative discourse type, that of research article writing, with no observable differences across cultural contexts and languages. Informal lexical choices like *get*, contracted forms (*'s*) or genitives occur in the BNC but not in SERAC, corroborating the higher level of formality of the SERAC texts.

Several grammar categories are represented fairly equally in the four frequency lists. As seen in Table 4.4, the grammatical categorization of lexical and function words is fairly homogeneous in the three subcorpora compared to that of the BNC. Grammatical categories in the BNC corpus were retrieved from Leech et al. (2001, p. 120). In the case of SERAC, some items perform several grammatical categories. For instance, in both the L1 and L2 English suhcorpora, *there* is far more common as an existential than as an adverbial, *to* is more common as *to* + inf. than as a preposition, *that* is more common a conjunct in *that*-clauses than a determiner/pronoun and *results* and *use* are more common as nouns than as verb forms. Grammatical categorization shows further similarities in the two English subcorpora and in the L1 Spanish subcorpus. In the three SERAC subsets of texts the range of prepositions is higher than in the general BNC corpus. As opposed to the BNC, the greater range of content words (nouns) in the three subsets of SERAC indicates higher lexical densities. The greatest range of content words can be seen in the L1 Spanish subset, indicating a distinctive lexical profile from that of the L1 and L2 English texts. The range of lexical choices of the L1 English texts across grammar categories is very similar to that of L2 English subcorpus (see, esp., determiners, determiners/pronouns, modal verbs, coordinating/subordinating conjuncts, adverbs, nouns and adjectives, for instance).

The specific profile of SERAC reveals further differences in the two subsets of English texts. To trace these differences, the 60 headwords and 393 inflected

Table 4.4 Grammatical categories of the top 100 words in the frequency lists of BNC and SERAC

PoS	BNC	L1 Eng	L2 Eng	L1 Sp
Prepositions	of, in, to, for, with, on, by, at, from, as, into, about, like	of, in, to, for, with, by, on, from, at, between, into, about, within, such as, through, after, over	of, in, to, for, with, by, on, from, at, between, into, about, through, such (as), during, after	de, en, a, de(l), por, con, para, como, a(l), entre, sobre, sin, desde, hasta, mediante, durante, (a) parte (de)
Determiners	the, a, an, his, their, her, its, my, your, our, no	the, a, an, their, his, its, our, no	the, a, an, their, its, our, his, no	la, el, los, las, un, una, su, sus
Determiners/ Pronouns	this, that, these, which, what, all, some, any	this, that, these, those, which, what, all, some, most, each, one, both	this, that, these, those, which, what one, all, some, most, both, each	este, esta, estos, estas, cada, otros, todo, otro, todos
Pronouns	it, I, you, he, they, she, we, them, him, me, her, who, one	it, we, they, he, (et) al, I, who, where, one	it, we, (et) al, they, I, when, where, one	que, los, se, lo, (et) al, nos, ello, donde
Verb forms	is, was, be, have, are, had, 's, were, do, been, has, said, did, know, see, get	is, are, was, be, were, have, has, used, been, using, use, had, based, results	is, are, be, was, were, have, has, been, used, use, using, obtained, related, based, results	es, ha, son, está, han, ser, fue, tiene, sido, forma
V modals	would, will, can, could, may, should	can, may, will, would	can, may, will, would, could	puede, pueden
Coordinating conjuncts	and, but, or	and, or, but, (both) . . . and	and, or, but, (both) . . . and	y, o, e, pero, tanto . . . (como)
Subordinating conjuncts	that, as, if, when, than	as, than, that, if, because, when, after	as, than, that, if, because, when, after	que, como, si, ya, cuando, aunque
Adverbs	so, up, then, out, now, only, just, more, also, very, well, how	also, only, however, (i).e., e.g., so, more, most, over, there	also, only, (i).e., however, more, most, there, thus	no, más, también, i.e., así, (por lo) tanto, muy, todo, bien, solo, además, (sin) embargo, (por otra) parte, (en) parte

Table 4.4 Cont'd

PoS	BNC	L1 Eng	L2 Eng	L1 Sp
Nouns	time, people, way	data, time, study, information, analysis, research, use, model, results, studies, work, fig., table, group, number, level	patients, analysis, study, results, time, cells, cell, data, number, use, table, information, case, research, fig., model, values, order	caso(s), trabajo, análisis, estudio(s), información, resultados, datos,pacientes, tipo, años, valor(es), nivel, sistema, relación, tiempo, número, proceso, lugar, grupo, tratamiento, parte
Adjectives	other, new	social, different, other, high, significant	different, other, same, new, high	mismo, diferentes, mayor, otras
Gen	's	—	—	—
to + inf.	to	to	to	—
Existential	there	there	there	—
Negation	not, n't,	not	not	—
Cardinals	one, two	one, two, three	one, two, three	dos
Ordinals	first	first	first	—

forms and derived forms of those words comprising Coxhead's (2000) *Academic Word List* (AWL) Sublist 1 were retrieved from the two comparable subsets of texts, L1 English and L2 English, using *Wordsmith Tools*. A log likelihood-ratio test (LL) was also applied to identify statistically significant overuse/underuse of this sublist in the L1 English subcorpus relative to the L2 English subcorpus. In the comparison L1 English was considered the normative corpus.

Wordsmith Tools computed a total of 72,002 occurrences (a normalized total of 5,307 per million words) of the 60 word families in the L1 English subcorpus and a total of 57,036 occurrences (5,149 per million words) in the L2 English subcorpus. With an overall LL value of 29.22, the statistical calculation indicates an overuse of this sublist ($p < 0.0001$) in the L1 English compared to the L2 English subset. Overall, 36 word families (60%) of AWL Sublist 1 are overrepresented in L1 English compared to L2 English and 24 (40%) are underrepresented in L1 English compared to L2 English (Table 4.5). The fact that statistically significant differences were found in 83.4 per cent of the total word families of Coxhead's Sublist 1 might be the result of the only non-confounding variable of the two comparable subcorpora in SERAC, that is, the use of English

Table 4.5 Statistical significance of AWL Sublist 1 in L1 English compared to L2 English

Statistical significance	L1 ENG compared to L2 ENG	AWL Sublist 1 Word families	Total percentage (%)	Cumulative percentage (%)
$p < 0.05$	Overuse	context, require	3.3	6.6
	Underuse	concept, policy	3.3	
$p < 0.01$	Overuse	benefit, create, per cent, similar, structure	8.3	11.6
	Underuse	derive, principle	3.3	
$p < 0.001$	Overuse	authority, involve, period	5.0	6.7
	Underuse	sector	1.7	
$p < 0.0001$	Overuse	assess, available, consist, contract, data, estimate, evident, income, indicate, individual, issue, labour/labor, major, research, respond, significant, source, theory	30.0	58.3
	Underuse	analyse/analyze, approach, area, constitute, define, environment, establish, finance, function, identify, interpret, method, occur, process, section, specific, vary	28.3	
No statistical difference	Overuse	economy, export, factor, formula, legal, legislate, proceed, role	13.3	16.6
	Underuse	assume, distribute	3.3	

as a native vs as an additional language. This variable may account for the over/underuse of these linguistic items.

Lexical (content) and grammar (function) words typically co-occur in multi-word lexicogrammatical patterns (Sinclair 2004), also called 'lexical bundles' (Biber et al. 1998, Hyland 2008), 'lexical phrases' (Hunston and Francis 1996) or 'formulaic expressions' (Simpson 2004). Drawing on these studies, a search for 3-word grams was retrieved from SERAC with *kfN-gram* in order to handle a broad spectrum in the process of identifying convergences and divergences

in the texts across the two cultural contexts and the two languages. This software shows that the comparison of the three SERAC subcorpora indicates that research article writing is highly formulaic with respect to the use of recurrent word patterns. Using a frequency level of 10 as a cut-off, across the three subcorpora scientific discourse appears to be constructed upon recurrent structural patterns (Table 4.6). The multi-word patterns of the lists below include expressions occurring at a level of 10 per million words and in at least 10 per cent of the texts. A minimum frequency of 10 times per million accounted for formulas 'not attributable to the idiosyncrasies of particular writers' (Simpson-Vlach and Ellis 2010, p. 493, see also Biber et al. 1999).

From the data retrieved, there seems to be a common single pool of word sequences, associated with the typical communicative purposes of scientific prose. Taking the whole lists of 3-grams some word sequences occur in the three sets of texts and are suggestive of the highly intertextual nature of the texts (*et al* ####), as well as of writers' need to provide factual evidence (*the presence of/la presencia de*, *the fact that/el hecho de*), signpost readers (*in this study/en este estudio*, *the other hand/por otro lado*), convey impersonality (*the results of/los resultados de*), causal relations and evaluation (*the importance of/la importancia de*). The overlapping items from the three lists (a total of 44 grams) can then be considered core formulas in research article writing, indicating that language has no impact in the comparison.

It is also interesting to note that some sequences are unique to each subcorpus. This is the case of *more likely to*, *likely to be*, *are likely to*, *each of the*, *the nature of*, *a function of*, *are more likely*, *the likelihood of*, *there was a*, *it is important*, *for example the*, *it may be* in L1 English. These recurring sequences show a clear preference for the expression of probability. In the L2 English texts, grams such as *it is possible*, *is related to*, *obtained from the*, *observed in the*, *it should be*, *seems to be*, *it can be*, *is based on*, *are shown in*, *included in the*, *the aim of*, *fig/table # shows*, *in section #*. The L2 English list of grams shows higher scores in the use of phraseological units embedding passive constructions and past participle clauses and textual metadiscourse expressions. The L1 Spanish subcorpus shows grams containing relative clause constructions (*en el/la/los que*, *a la/las que*, *de lo que*, *que se han*), *that*-complement clauses (*que en la*, *de que la/los*), concessive grams (*a pesar de*) and linking grams (*por lo tanto*, *por lo que*, *en cuanto a/al*). These syntactic preferences might further explain the corpus data above indicating that the number of words per sentence in this subcorpus is higher compared to the two English subcorpora. Overall, these non-overlapping units show that although the production of texts is fairly standardized in terms of lexicogrammar, to some extent culture and language exert an impact on writers' preferred linguistic choices.

Keeping the data set to a more restrictive size for a structural categorization, a 4-gram search confirms that these grams form recurring structural units and that there is considerable structural affinity in the three subcorpora. As Hyland (2008) and Biber and Gray (2010) also explain, there is a significant

Table 4.6 Top fifty 3-grams in SERAC 2.0

L1 English	L2 English	L1 Spanish
et al ####	*et al ####*	*et al ####*
as well as	*in order to*	*a partir de*
the number of	*the number of*	*a través de*
the use of	*the use of*	*el caso de*
in order to	*as well as*	*en el caso*
in table #	*the presence of*	*uno de los*
in terms of	*one of the*	*por lo que*
# and #	*# and #*	*en el que*
the presence of	*the fact that*	*el número de*
one of the	*part of the*	*una de las*
a number of	*in terms of*	*la mayoría de*
in this study	*the case of*	*en cuanto a*
in fig #	*according to the*	*la presencia de*
## and ##	*due to the*	*en la tabla*
the effects of	*in table #*	*el ## de*
more likely to	*on the other*	*la tabla #*
the fact that	*related to the*	*en los que*
the effect of	*## and ##*	*se trata de*
there is a	*in the case*	*la existencia de*
based on the	*based on the*	*en la que*
each of the	*by means of*	*lo que se*
the relationship between	*the other hand*	*este tipo de*
the results of	*in which the*	*a lo largo*
part of the	*with respect to*	*a pesar de*
likely to be	*the end of*	*el análisis de*
## of the	*the existence of*	*# y #*
as a result	*in fig #*	*por otra parte*
due to the	*the development of*	*de la información*
al #### the	*at ## c*	*por otro lado*
the development of	*the effect of*	*la figura #*
because of the	*analysis of the*	*de la empresa*
al #### and	*in this case*	*el proceso de*
the end of	*al #### the*	*el grado de*
on the other	*there is a*	*que en el*
the united states	*such as the*	*y de la*
in which the	*end of the*	*el uso de*
end of the	*most of the*	*los resultados de*
the role of	*the results of*	*el hecho de*
such as the	*in this study*	*de los pacientes*
the level of	*in the first*	*en este caso*
the present study	*fig # the*	*la necesidad de*
in addition to	*it has been*	*los que se*
some of the	*in the same*	*el desarrollo de*
table # the	*it can be*	*la que se*
the importance of	*a set of*	*punto de vista*
it is not	*table # the*	*cada uno de*
there is no	*# shows the*	*una serie de*
the other hand	*the present study*	*el estudio de*
the case of	*respect to the*	*el que se*
the majority of	*in patients with*	*en la figura*

use of phrasal embedding that favours complexity, elaboration and explicitness in scientific writing. The 4-grams form recurring structural units: noun phrases embedding phrasal (non-clausal) postmodifier fragments (*the end of the*, *the rest of the*, *the results of the*), noun phrases + *that*-clauses (*the fact that the*, *el hecho de que*), prepositional phases + *of* phrase fragment (*on the basis of*, *in the case of*, *at the time of*), other prepositional phrases (*on the other hand*), passives + prep phrase fragments (*shown in fig #*).

Understanding scientific discourse is seeing how the lexicogrammatical units actually perform several discourse functions and produce different rhetorical effects. As stated earlier, contextual analysis was used to identify the primary discourse functions that recurring 3-grams perform in the three subsets of texts. Three broad categories of functions were identified. First, grams performing the function of providing contextual truth (i.e. intertextuality) and, second, grams performing the function of providing evidential truth (i.e. referentiality). Drawing on Ädel's (2008), contextual analysis further shows that a third subset of grams performs metadiscourse functions (i.e. reflexivity), both text-oriented and participant-oriented. With p set at .01, text-oriented grams performing the text-oriented metadiscourse functions of introducing the topic and arguing (expressing an opinion) and participant-oriented grams such as anticipating the readers' reaction show statistically insignificant differences ($p > .01$) in the chi-square test, indicating that the language of the corpora (L1 English, L2 English and L1 Spanish) has no effect on the variation in these discourse functions. This indicates that these phraseological choices and discoursal effects are consistently used by the three sets of writers. Conversely, 3-grams embedding intertextual material and expressions of evidential truth, as well as grams performing the participant-oriented metadiscourse functions of aligning perspectives and appealing to readers showed statistically significant differences ($p < .01$) in the chi-square test, indicating that the language of the corpora (L1 English, L2 English and L1 Spanish) has an effect on the variation in these discourse functions. This indicates that these phraseological choices/preferences and discoursal strategies differ depending on the language the writers use. In conclusion, these figures point to a sizable, but not complete, degree of linguistic standardization in the n-grams used in research articles across the three corpora being compared, with language affecting partially but not completely this level of linguistic standardization. A qualitative, context-based analysis of the discourse functions of grams, pointing both to convergences and divergences, is provided in the following sections of this chapter.

Research Telling: Intertextuality and Referentiality

The context-based analysis of the discoursal functionality of higher frequency grams in SERAC indicates two similar ways of 'telling' research in the two

cultural contexts and in the two languages: intertextuality, scoring top in the rank (see Table 4.6), and referentiality.

Drawing on the Bakhtinian postulates on the dialogic nature of language, Kristeva (1980, p. 37) argued that every text is 'constructed as a mosaic of quotations'. Also called multivoicedness, intertextuality involves using prior texts. As reflected in the recurrence of intertextuality related grams in the SERAC subcorpora, the presence of other texts and other voices shows highly conventionalized ways to render the writers' account of the origin, motivation and significance of the research reported in the article. In addition, manifest intertextuality – that is, texts explicitly present in the text (Fairclough 1993, p. 104) – is not only a means of showing acquaintance with the field of research but also of constructing a credible writer persona that may counteract vulnerability for possible criticism on the part of the readership. As shown in the previous section, the standardized use of intertexts scored the highest frequency n-grams in the L1 and L2 English subcorpora and, to a lesser extent, in the L1 Spanish subcorpus. It should further be noticed, though, that the n-gram *et al.* #### is just but one linguistic trace of the intertextual dimension of discourse, as it instantiates references to co-authored texts. In addition to co-authored texts, the mosaic of quotations and references to previous texts also encompasses other intertexts that are more difficult to trace with a concordance programme. These intertexts are, for instance, citations of single-authored texts, two-authored texts (e.g. referenced as 'Smith 2003', 'Johns and Smith 1978', etc.) or citations indicated by small numbers to refer to key original papers consecutively. Generally speaking, the proportion of non-integral citations is comparatively higher than that of integral citations in which cited authors are clause elements. Across disciplinary domains, integral citations formed by human subjects followed by reporting verbs tend to be more common in the humanities, followed at a distance by the social sciences texts.

Wordsmith Tools dispersion plot further shows that in the three SERAC subcorpora there tends to be a much higher concentration of intertextual references in the Introduction sections of the articles and that this concentration is fairly consistent across disciplinary domains, not an unexpected fact considering the well-established genre conventions of research article writing. The standard use of what Swales (2004, pp. 234–5) describes as the 'hourglass metaphor' of the overall shape of Introductions – 'the work of others (theories, findings, methodologies) and/or something in the "real world" is taken as primary, while the research to be reported is taken as secondary' – proves to be a recurrent communicative practice in the three SERAC subsets. Across disciplinary domains, citations help scientists show acquaintance with current research in the discipline and establish the research territory (Move 1). Through citations, writers contextualize their study and establish the research territory either by defining the topic under investigation or ascribing interestingness or relevance to it, usually referring to the impact or scope of the study.

Samraj (2002, p. 227) notes that 'reviewing previous literature and incorporating citations to other work is by no means restricted to the second half of the opening (M1) but can occur throughout the Introduction and throughout the article as a whole'. Data from SERAC 2.0 likewise shows higher density of citations in Move 1, which includes between 70–80 per cent of the total number of citations in the L1 and L2 English subsets.

The close analysis of intertextual grams also shows that having established the research territory writers create a gap in research, raise a question (i.e. the CARS model, cf. Swales 1981), or simply further the research line (i.e. the OARO model). Citation acts as a strategic resource for creating the research niche in Move 2 of Introductions, 'Create a Research Space'. In this move writers use citations to identify a research gap and later 'occupy' the gap or provide a research option with a statement of purpose (Move 3). In doing so, intertextual references are often accompanied by academic criticism. Critical citations in Move 2 are accompanied by explicit gap indications (e.g. *however*, *disadvantage*, *little support*, *appear to contradict*, *no comparative study has evaluated*, etc.) prior to writers' announcement of research goals with positive indicators in Move 3 (e.g. *can be achieved*, *to solve x*, etc.):

> Massey et al. (1994) offer little support for the argument that the out-migration of African-Americans from impoverished inner-city neighborhoods has become more class selective over time [. . .]. (L1 English, sociology)
>
> Uncommitted progenitor cells express Snai2 and aberrant activation of Snai2 pathways is key in the development of cancers derived from many tissues (Inoue et al. 2002; Pérez-Losada et al. 2002; Pérez-Mancera et al. 2005). The implication of SNAI2 in human cancer seems to be wider than initially expected (Elloul et al. 2005; Gupta et al. 2005; Shih et al. 2005; Bermejo-Rodriguez et al. 2006; Come et al. 2006). Nevertheless, the molecular mechanisms by which SNAI2 participates in these biological processes are not yet clear. (L2 English, information science)
>
> Los materiales devónicos de la Formación Alternancia de Rodanas presentan, en la zona de Tabuenca concreciones carbonatadas dispersas en lutitas y limolitas. Estos materials *han sido escasamente estudiados* [*have been hardly approached*], ya que sólo únicamente Gózalo (1984, 1986 y 1994), Bauluz (1997), Bauluz et al. (1995a, b y 2000) y Torrijo (1999) los *han analizado en detalle* [*only . . . have analyzed them in detail*]. (L1 Spanish, earth sciences)

The use of intertextual grams in Methods sections of experimental fields conveys credibility to the methodological foundations of the study (e.g. *I follow Held et al. (1999) in operationalizing the extension of* [. . .], *Our control variables replicate the baseline model used by Land et al. (1999)*). Seeking credibility and giving significance to findings in moving the field ahead are recurring discourse functions of intertextual references in Results and, above all, Discussions.

As claimed by socio-constructivist approaches to citations (Gilbert 1977, Myers 1990, Hyland 2002), citations are used strategically to bolster argumentation. In reporting findings and comparing current findings with previous studies, writers combine intertextual references with inanimate subjects (e.g. *this study confirms*), modals and epistemic modals (*may*, *believe*, *could*) and evaluative lexis (*essential*, *critical*, etc.). This discoursal manoeuvre is most noticeable in the L1 and L2 English texts. Self-citations and citations of authoritative work – most of the times, journal citations – indicate that citations strategically represent 'intellectual duty for the work of others' (Repanovici 2010, cf. also Hewings et al. 2010) for persuasion purposes:

> It is essential for small businesses in today's competitive environment to take a strategic approach to their information needs if they wish to develop and remain competitive. If information expertise is not present within the company, it is advisable to invest in that expertise through recruitment, training, partnership, or outsourcing. This study confirms previous research findings relating to the critical role of information in organizations and specifically in small and medium-sized enterprises (Huotari 1995; Marchand 2001; Wong and Aspinwall 2005; Achanga et al. 2006). (L1 English, information science)
>
> Owing to obvious ethical and legal reasons, this pilot study was conducted in a cohort of terminal patients harbouring actively growing recurrent tumours. Although the use of cannabinoids in medicine may be limited by their well-known psychotropic effects, it is generally believed that cannabinoids display a fair drug safety profile and that their potential adverse effects are within the range of those accepted for other medications, especially in cancer treatment (Guzman, 2003; Hall et al. 2005; Iversen, 2005). In line with this idea, THC delivery in our study was safe and could be achieved without overt psychoactive effects. (L2 English oncology)

As a form of manifest intertextuality, expressions of attribution marked by prepositional phrases (n-grams) such as *according to the*, *the point of view*, (*from) the point of view* (*of*), in L1 and L2 English and *de acuerdo con*, (*desde*) *el/un punto de vista* (*de*), in the L Spanish subcorpus consistently indicate lexicogrammatical standardization in the SERAC texts. In sum, intertextuality in its accompanying co-text lends credence to the very competitive research landscape and is subject to language impact (cf. also Okamura 2008).

Alongside intertextual material, high-frequency n-grams across the three subcorpora show that scientific research reporting is characterized by referential and factual evidence. Referential grams aim at identifying entities from the external world and distinguishing their qualities and attributes. Referential expressions are formed by complex NPs followed by prepositional phrases used

for the specification of referents and attributes: *the/a number of, the use of, the presence of, the absence of, the use of, the effects of, the role of, the level of, the development of, the case of, the nature of the*. Similar patterning in the L1 and L2 English texts can be found in the L1 Spanish texts (*la presencia de, la existencia de, el análisis de, el proceso de, el grado de, el desarrollo de, la utilización de*, etc.). The n-gram search also brings to light high frequency of time/place references (*at the end of the, the end of, at the time of, a la hora de*). To single out referents partitive/quantifying grams such as *one of the, part of the, some of the, the case of*, etc. in the L1 and L2 English texts, and grams such as *uno de los, una de las, el resto de, una serie de, parte de las, la mayor parte de, mayoría de los*, etc. also in the L1 Spanish texts are also used. These different grams tend to be evenly distributed across the different rhetorical sections of the texts (Introductions, Methods, Results, Discussions/Conclusions). From a functional standpoint, these structural patterns serve to the accuracy and propriety of research reporting by referring to the identification of referents.

Other recurring structural patterns linking complex noun phrases are those that explicitly indicate relationships between referents. The n-gram analysis reveals linguistic standardization in the use of phraseological patterns (namely, *the relationship between, is related to* and *in relation to*) across the three subcorpora. Scientific discourse involves establishing connections/relations between entities and understanding the behaviour of such connections/relations. The gram *the relationship between/la relación entre* is shared by the three subsets of texts. In its accompanying co-text this gram tends to occur in the critical literature review, in the Occupying the research niche niche, in the discussion of results and when writers refer to methodological procedures. These discourse functions indicate that research enquiry generally relies on relationships between referents:

> The goal of the current study is to empirically investigate the relationship between learners' noticing in the L2 classroom and their L2 learning outcomes. (L1 English, applied linguistics, Introduction, Occupying the niche)
>
> A number of other authors have also studied the relationship between trauma, identity and narrative. (L1 English, Introduction, Critical literature review)
>
> We also aim to analyse the relationship between group identification and negative personal emotions, a variable we have termed personal negative emotional response. (L2 English, sociology, Introduction, Occupying the niche)
>
> The relationship between genetic alterations in 3p and multifocality has been previously described. (L2 English, urology, Introduction, Critical literature review)

> Finally, the relationship between QOL and LUTS was analysed using separate stepwise linear regression analyses, adjusting for age, which correlated significantly with the criterion. (L2 English, urology, Discussion)
>
> Se ha intentado obtener correlaciones entre los parámetros morfométricos estudiados por Williams (1972), como *la relación entre* [*the relationship between*] el volumen de la dolina y la distancia al vecino más próximo. (L1 Spanish, earth sciences, Methods)
>
> Se evidencia así *la relación entre* [*the relationship between*] cultura política y propensión individual a la participación pública y cómo la socialización política en el país de origen mantiene su peso en el receptor44. (L1 Spanish, sociology, Discussion)

Scientific discourse is also built upon recurring structural patterns indicating text-visual relationships. Grams such as *in table #*, *in fig #*, *table # the*, *fig # the*, *of table #* in the L1 and L2 English texts, and equivalent grams in the L1 Spanish subset (*en la tabla*, *la tabla #*, la *figura #*, *en la figura*) are direct references to sources of factual evidence given in the form of data, values, etc. These grams strengthen the credibility of the research telling on the basis of factual evidence. Longer 5-grams such as *are shown in table #*, *as shown in fig #*, *shown in table # the*, *as shown in table #*, *is shown in fig #*, *shown in fig # the*, *are shown in fig #*, *is shown in table #*, *table # shows the results* also recur in the L1 Spanish subset of texts (*en la tabla # se*, *en la figura # se*, etc.). The dispersion plot indicates that these patterns mainly occur in the Results sections of the RAs in the three subcorpora. Except for the literature texts, in all the sub-disciplinary domains these grams perform a similar function across the three subcorpora, that of enhancing acceptability of the claims made in the article. The examples below illustrate the standardization practices in supporting references to referents (*specimens*, *samples*, *conditions*, *values*) and qualifiers of referents (*parameters*, *differences*, *characteristics*, *antecedents*, etc.) by means of visuals. Across disciplinary domains, references to visual information strengthen the truthfulness of the propositions (e.g. *The assignment of tactics to ISS conditions is shown in Table 5*, [. . .] *the three interpolation methods on the cone and lava flow DEMs are shown in Table 4*, *En la figura 2 [In figure 2] aparece el mapa simétrico del análisis de correspondencias multiple*).

The Discourse Functions of Reflexivity in Language

A look at the 3-gram search shows that although scientific discourse is overwhelmingly referential and intertextual as far as research telling is concerned, a small amount of grams indicate a fairly standardized use of reflexivity in language, that is, metadiscourse material. In agreement with Ädel (2006, p. 195, see also Pérez-Llantada 2010a), the amount of textual material referring to the world of the text or to its participants (as defined by the non-integrative

approach to metadiscourse), according to the 3-gram search, is very low compared to the amount of textual material referring to the real world (i.e. the referential meaning described in the section above). In the case of SERAC, the text-oriented functions performed by metadiscourse grams bring to the surface the importance of introducing the topic, arguing or expressing an opinion. On the other hand, the participant-oriented functions identified in the gram analysis indicate that anticipating the readers' reaction, aligning perspectives and appealing to readers are the most prominent discourse functions of text-reflexive material. Context-based analysis of the grams further shows that the micro-level discourse functions of text-oriented types, as also happens with participant-oriented functions, tend to occur in specific information moves of the different research article sections and thus perform different communicative roles.

A major set of metadiscourse n-grams comprises references to textual material across the different disciplinary domains. Similar standardized patterns occur in the three subcorpora. Recurring discourse organizing structural units introducing the topic are *in this study*, *the present study*, *of this study*, *of/in this paper/de/en este trabajo*, some of which cluster in 5-grams such as *in the present study we*, *of this paper is to*, *(el) objetivo de este trabajo (es)*. These grams generally occur in Move 3 of Introductions (Occupying the research niche) and, to a lesser extent, in Move 1 of Discussions (Re-statement of purpose).

> In this study, I focus on the strategies of Rosa Coldfield and Isabel Moncada, the central female characters of the narratives. (L1 English, literature, Introduction)
>
> In this study, we explored an explanation for CEO postacquisition departure – human capital – that is both new to the research literature and complementary to existing theory. (L1 English, business management, Discussion)
>
> The goal of the present study was to evaluate the long-term oncologic safety and to determine the risk of tumor progression among patients enrolled in an active surveillance program for low-risk bladder cancer. (L2 English, urology, Introduction)
>
> In the present study we retrospectively reviewed our experience in the surgical management of UUT-TCC, including the effect of treatment period on survival. (L2 English, urology, Discussion)

The concordance lines below also show that grams introducing the topic occur in different clause constructions and display a highly standardized phraseology: adverbial prepositional phrases with references to discourse participants (*I/we*), noun modifying Prep phrases embedding cognitive constructs (*results*, *study*, etc.) as noun heads, NPs in subject position and anticipatory *it*-patterns followed by *to*-infinitive clauses containing research/discourse procedures such as *discuss*, *propose*, *examine*, *describe*, *determine* or *report*:

N Concordance
1 ne, 1974; Kolm, 1976). The aim of this paper is to propose a
2 s. 5. Discussion The first aim of this paper is to determine
3 rted for the core. A third aim of this paper is to explore t
4 n deep time. The principal aim of this paper is to show, usi
5 omas (2007). It is not the aim of this paper to address the
6 text, and outline the main aim of this paper in the context
7 ortes 1998; Lin 2001). The aim of this paper is to provide s
8 eferences. CONCLUSIONS The aim of this paper has been to exa
9 pment in Latin America The aim of this paper is to consider
10 text. The chronotopic approach of this paper will analyze th
11 ranslation, the basic argument of this paper, that the Dark
12 odel outlined at the beginning of this paper claimed that pr
13 o the second main contribution of this paper: establishing t
14 available to firms, the focus of this paper is on the effec
15 challenges that are the focus of this paper. Furthermore, t
16 d design-one that is the focus of this paper-supplements a l
17 ental gender Because the focus of this paper is on single pa
18 l degrees of freedom. The goal of this paper is to help corr
19 vices can be difficult. The goal of this paper is to provide d
20 areas. 6. Discussion The goals of this paper were essentiall

Text-reflexive grams often co-occur with the 3-gram *to determine the*. While clusters such as *in order to determine the*, *was/were used to determine the*, *be used to determine the* or *to determine the effects of* occur in the L1 and L2 English texts, no equivalent constructions are found in the L1 Spanish texts. In Introductions following the CARS model, both in the L1 and L2 texts, these grams mainly appear in Moves 2 and 3, when writers create and occupy the research niche by introducing the statement of purpose, as in the extracts below:

> It seems then that there is evidence that some metaphors are common to a number of languages, but a great deal more work is needed to determine the extent and relative frequencies of shared metaphors. (L1 English, applied linguistics, Creating the research niche)

> The objective of this study was to determine the influence of desalting and boiling with or without vacuum packaging on the chemical and lipid composition of the muscles of deboned pieces of dry-cured pork forelegs. (L2 English, food technology, Occupying the research niche)

In Methods section, this gram conveys clarity and accuracy in research telling as well as rigour in the handling of scientific procedures, always with a view to facilitating to other researchers the replicability of the study:

> Regression models were used to determine the effect of surgical procedure (RN vs PN) and access technique (open vs laparoscopic) [. . .]. (L1 English, urology)
>
> The RMSE of both relations have been subsequently calculated to determine the mean error estimates. (L2 English, geology)

In Results and Discussion sections this gram explicitly reminds readers of the scope of the study and of the research procedures used by the scientist to conduct the study. In this case the gram is preceded by copular verb *be* in the past tense (*was/were*). In these rhetorical sections the grams co-occur with impersonal and modalized language, above all when scientists state limitations or claim provisionality of the findings, as in the second example:

> It is noted that, in one case, it was impossible to determine the depth of invasion of the tumour because the patient failed to respond to the intracavernosal aprostadil injection. (L1 English, urology, Discussion)
>
> The primary end point of the study was to determine the safety of intracranial THC administration. We also assessed THC action on the length of survival and various tumour-cell parameters. (L2 English, oncology, Results)

In addition to introducing the statement of purpose, recurring discourse organizing grams also function to indicate the overall structure of the text. These text-oriented structural units facilitate the readers' processing of the subsequent text and can be taken to be 'an expression of the self-awareness of the text, or more precisely, as the author's explication of his or her awareness of the text as text' (Mauranen 1993b, p. 165). Location sentence fragments such as *in the next section*, *a large segment of this paper is devoted to*, *outlined at the beginning of this paper*, *the remainder of this paper*, *the first section of this paper*, etc., facilitate to readers the processing of the subsequent text. The following extracts also illustrate the use of internal discourse connectors (*first*, *second*, *third*, *finally*) marking low explicitness text-reflexivity:

> The remainder of the paper is organized as follows. First, the current state of the hospital industry is described, followed by a discussion of complexity absorption and complexity reduction responses. [. . .]. Next is a discussion of Porter (1980) generic strategies as a complicating mechanism, as well as the potential influence of perceived environmental dynamism on the strategy-performance linkage. This is followed by a discussion of the performance effect of analytical comprehensiveness in dynamic settings. Finally, organizational structure is assessed for its moderating influence on the performance effect of strategy and analytical comprehensiveness. [. . .]. This is followed by a description of sample construction and research methodology, results and

> discussion, along with conclusions, limitations, and suggested directions for future research. (L1 English, business management)
>
> The remainder of this paper is organized as follows. In the next section, we examine the changing context of the newspaper business in Spain, which shifted from state censorship and intervention, during the dictatorship, to the freedom of speech and liberalization of the economy that characterize a democracy. Our discussion then addresses the extent to which the value attributed to independent certification and the ultimate likelihood of firm failure, which is a potential consequence of such processes, is influenced by different political regimes. This section is followed by a description of our research setting, methods and findings. Finally, we discuss the results of this investigation and make some suggestions for future research in this area. (L2 English, business management)
>
> *El resto del trabajo se estructura de la siguiente forma [The remainder of this paper is organized as follows]; en el segundo apartado se revisan* [*in the second section x are revised*] algunos de los posibles determinantes de la presencia de estructuras de propiedad concentrada entre las grandes empresas, incidiendo en la importancia que toma la naturaleza de los accionistas controladores como dimensión de la estructura de propiedad. *En la tercera sección describimos* [*in section three we describe*] la metodología utilizada, así como la determinación de la muestra y las fuentes de información a las que hemos acudido. *En el apartado cuarto presentamos los resultados del estudio* [*In the fourth section we present the results of the study*]. *Finalmente en la sección cinco* [*Finally, in section five, the main conclusions of the study are provided*] se exponen las principales conclusiones del trabajo. (L1 Spanish, business management)

In using text-oriented grams performing the function of arguing with readers, that is, expressing an opinion, writers in the two cultural contexts and in the two languages claim centrality of their research. As also pointed out by Biber et al. (1999) and Hyland's (2008) studies of lexical bundles in academic prose, a recurring pattern in SERAC is the one embedding an abstract noun as the head of a NP followed by a *that*-clause. This structural unit foregrounds impartiality and objectivity in research reporting but implicitly conveys propriety and relevance to the writers' opinion on factual evidence. Put it simply, it expresses interpretive evidence expressed by writers' evaluation of factual evidence. The most recurring arguing unit conveying writers' interpretive evidence in the three subsets of texts is the gram *the fact that*, in the English subsets of texts and *el hecho de, hecho de que* in the Spanish subset. These grams form longer grams such as *the fact that the, to the fact that, by the fact that, el hecho de que* in the L2 English and L1 Spanish subsets. Even high-frequency 5-grams such as *por el hecho de que, el hecho de que el/la*, occur in the subset of Spanish texts, which might indicate that there is a possible L1 to L2 transfer in the L2 English texts.

In fact, the range of linguistic realizations of these grams is greater in the L2 (*the fact that*, *fact that the*, *to the fact*, *fact that the*, *to the fact*, *the fact that the*, *by the fact that*, *due to the fact that*, *to the fact that the*) than in the L1 English texts (only *the fact that*, *fact that the* and *the fact that the* occur). In Introduction sections these structural units implicitly foreground the interest and rationale for the claims made in the paper. *Wordsmith Tools* dispersion plot shows that these grams generally tend to concentrate in the Discussion sections of experimental papers and in the body of humanities papers, suggesting writers' greater persuasive efforts to get readers' acceptance of the new knowledge claims. In the three subsets of texts these grams are comparatively more frequent in the texts belonging to the social sciences and humanities disciplines.

Close analysis of the texts indicates that these grams serve to strengthen writers' authority as well as credibility in the reporting of research findings. As shown below, writers persuasively place factual-based evidence in thematic position/thematizing in order to tell readers the authorial viewpoint or interpretive evidence (e.g. *The fact that the procedure we present manages to reduce the possible variants to this extent can be considered a satisfactory result*). As for the comparison between L1 and L2 English, these arguing grams tend to co-occur with evaluative statements (e.g. *quite clear*, *more important*, *in fact*) and an overall unhedged discourse that help writers make more forceful claims. As seen in the first two examples below, thematic development foregrounds experimental or observational evidence linked to Conclusions (Šeškauskienė 2009, p. 85). In conveying interpretation of factual evidence, these grams strengthen the conclusions and implications derived from the study reported in the paper. The comparison across languages indicates that in the L1 Spanish texts arguing grams are embedded within abundant clausal subordination and complementation, hence constructing a digressive argumentative flow. As also explained later in this chapter, this cause-effect line of reasoning is a typical face-saving strategy of Spanish academic prose:

> [. . .], the fact that it is not possible for him to say for certain that Pattie does not comprehend the world around her leads us to also conclude that he is making an assumption of her conceptual point of view. (L1 English, literature)

> The fact that the procedure we present manages to reduce the possible variants to this extent can be considered a satisfactory result. (L2 English, information science)

> *El hecho de que* [*The fact that*] Internet Explorer tenga una posición de monopolio en los clientes lo convierte en punto de referencia a la hora de acceder a una página Web y, *dado que* [*and since*] en muchas ocasiones ignora los estándares de diseño, perjudica a la accesibilidad en el diseño de páginas Web, *porque* [*because*] algunas soluciones propuestas en las normas más

> novedosas del W3C no son de aplicación para el navegador de Microsoft, *debiendo buscar* [*having to search for*] *una solución alternativa que satisfaga* [*a solution that satisfies*] a este navegador y a la norma, con *la consecuente pérdida de tiempo que este hecho conlleva* [*the subsequent loss of time that this fact involves*]. (L1 Spanish, information science)

Also performing an arguing function, existential *there*-constructions such as *there is a*, *there was a* and *there is no* also recur in the two English subcorpora and are used to bolster factual evidence based on scientific facts and experimentation. A cluster search of these evidential grams further reveals two recurring clusters, *there is a need to* and *suggests that there is a* (introducing conclusions) performing rhetorically (indicating a gap, and introducing conclusions, respectively) in the two sets of English texts. The comparison of the English and Spanish texts indicates the use of similar standardized patterns (*there is no/no hay*) which recurrently combine with nouns such as *explanation/explicacion*(*es*), *difference/diferencia(s)*, *way/medio*, *evidence/evidencia*, *doubt/duda* or *reason/razón*:

> Despite the large uncertainty in the measurements due to the magnitude of the standard deviations, there is a trend consistent with calculation of PVR, showing that CFHs, with the exception of MP4, significantly increase PVR. (L1 English, haematology)
>
> It is striking that there is a noteworthy presence of electronic collections of literary works, those most widely in place being Literature Online (LION) and Early English Books. (L2 English, information science)
>
> Los resultados plantean una enorme congruencia, pues en general no hay diferencias [*there are no differences*] sobre la valoración de la adquisición de estas competencias a lo largo de los estudios. (L1 Spanish, sociology)

In sum, the relatively close resemblance of common phraseological units performing text-oriented metadiscourse functions in the three subsets of texts may substantiate that scientific writing for publication is fairly standardized no matter what language the texts are produced in. Reflexivity in scientific discourse aims at 'influencing the recipient's interpretation of the content conveyed in discourse, and is therefore a means of persuasion' (Bondi 2010, p. 165).

Research Telling and Selling in Scientific Discourse

It was stated earlier that 'language' had an effect on the use participant-oriented functions of metadiscourse units in the three SERAC subsets, hence pointing to divergent paths as regards research selling purposes. From the 3-gram search anticipating the readers' reaction, aligning perspectives and

appealing to readers are in fact the most prominent primary discourse functions of metadiscourse material. This suggests that research reporting involves not only research telling but also writers' awareness of writer/reader interaction for research selling purposes.

A set of high explicit reflexive units are those writers use to tell readers when to link textual material to visual material. This is the case of grams such as *can be seen in* or *as can be seen*. These units serve writers to align perspectives by overtly inviting readers to look at the visual data accompanying the text (e.g. *This can be seen in the data*, *As can be seen in Table #*, *the results show* [. . .]. etc.). Another set of units are those that anticipate the readers' reaction by drawing upon grams embedding probability markers (*likely*, *likelihood*). Similar phraseology across the three subsets of texts suggests that scientific knowledge reporting is not fully categorical but provisional, as also argued earlier in this volume. Grams such as *more likely to*, *likely to be*, *is/are likely to*, *are more likely* and *the likelihood of* anticipate to readers' possible criticism by making the research reporting tentative and subject to the provisionality of the nature of scientific facts. As expected according to the genre conventions, these grams generally recur in the Discussion and Conclusion sections and convey speculation and low degree of authorial commitment to propositional meanings, hence showing writers' awareness of possible confrontations of scientific knowledge (e.g. *the effect is likely to be reinforced by* [. . .], *This concentration of deposits is likely to imply a climatic variability*).

Provisional reporting and low degree of authorial commitment can also be observed in the use of the impersonal 3-gram *the results of*, which also forms longer grams such as *the results of the/this*, *the results of the study*. In L1 Spanish, *los resultados de (la)*, *los resultados obtenidos en*, *análisis de la*, *el análisis de*, *en el análisis*, are also high-frequency grams suggesting that L1 and L2 English writers and L1 Spanish writers all prefer the use of impersonal standardized lexicogrammar patterns containing abstract nouns such as *analysis* and *study* to refer to their own research. However, writers' 'invisibility' in the texts only makes research reporting detached, even tentative, in the L2 English and L1 Spanish texts. In the L1 English texts, these impersonal grams tend to co-occur with evaluative markers boosting propositional meaning, as in the examples below, taken from the same discipline:

> The results of this study yield two major contributions to the research and management of technology standards. (L1 English, business management, Discussion)
>
> The results of the study show the presence of three main trends within the RBT. (L2 English, business management, Discussion)
>
> A menudo, resulta difícil justificar las inversiones y los cambios organizativos que sirven para desarrollar la flexibilidad, pero *los resultados del estudio*

> *sugieren que* [*the results of the study suggest that*] la mejora en la flexibilidad de la cadena de suministro puede conducir a mejores resultados financieros y de mercado. (L1 Spanish, business management, Discussion)

Counterbalancing the hedging effects of grams anticipating the readers' reaction, grams such as *it is possible/es possible que* and *the possibility of/la posibilidad de* also convey possibility meanings. In research reporting, both in L1 and L2 English, and in Spanish, these grams construct an assertive argumentative style 'with the aim of correcting or entreating the reader' (Ädel 2008, p. 49). This is the discourse function of anticipatory *it*-grams, which provide evidential comments, direct the reader and highlight points that are salient according to the writers' point of view. Grams expressing evaluative values occur across disciplinary domains, particularly in Discussion sections. Impersonal patterns followed by evaluative adjectives *importante* and *interesante* are not found in the 3-gram search in the L1 Spanish texts. The use of promotional language patterns in English-language journals might then be taken as an indication of greater competition and pressure to publish as opposed to publication in national-based journals.

Anticipatory *it*-patterns followed by *to*-infinitive or complement *that*-clauses or by adjectives form 5-grams such as *it is important to note*, *is important to note that*, *is interesting to note that*, *it is interesting to note* and *it is worth noting that* are used by both L1 and L2 English texts for appealing to readers. In the two sets of English texts, grams embed evaluative lexis (e.g. *important*, *interesting*) with the aim of entreating readers and inviting them to share similar lines of thought:

> It is interesting to note that whereas the solicit action move brings the company into the soliciting, the rest of the text has a direct association, personally, with the writer of the text to the act s/he is performing, which is mainly disclosing and reporting information. (L1 English, applied linguistics)
>
> It is important to note that, except for more haematologic toxicity during Cl and increased toxicity requiring dose reduction in the reinductions in young adults, there were no relevant differences between AYA with regard to treatment-related toxicity and morbidity. (L2 English, oncology)

Other high-frequency grams such as *play an important role in*, *should be taken into account* also perform an appealing function towards participants. Interestingly, this former gram tends to be modalized (by the modal *may*) in the L1 English texts and often co-occurs with other modalized markers (e.g. *seems likely*). This is not the case of the L2 English texts. As for the latter gram, the equivalent grams in Spanish, *hay que tener en cuenta que* and *que tener en cuenta que* are unmodalized since they do not include any modalized item such as *should*. As a result, the argumentative flow becomes rhetorically more assertive in the two subsets of texts written by the Spanish academics. These different clines of authorial commitment to claims across languages can be best seen in these examples:

> [. . .] other political, social, and financial factors that may play an important role in determining how shareholders value investments across these locations. (L1 English, business management)
>
> If, as seems likely, certain areas of research have a greater expectation of citing and being cited (e.g. music psychology), this factor should be taken into account in a bibliometric assessment process. (L1 English, information science)
>
> Two other factors play an important role in this coast: the reduction of fluvial sediment [. . .] and above all, storm wave action. (L2 English, geology)
>
> Además, hay que tener en cuenta que, en función del tipo de actividad en el que se englobe la futura empresa, *deberá* [*must*] acudirse a la conselleria u organismo correspondiente. (L1 Spanish, business management)
>
> Hay que tener en cuenta que con el desarrollo de la Investigación clínica cada día se es más exigente con el diseño y realización de un ensayo clínico; también *debemos* [*we must*] considerar la dificultad real para incluir grandes grupos de pacientes con estas características [. . .]. (L1 Spanish, oncology)

Appealing to readers by means of expressions of commitment is also the primary discourse function of grams such as *the importance of*, *the most important*, used by the L1 and L2 English writers for research selling purposes. A similar evaluative pattern, *la importancia de* can be found in the L1 Spanish texts. These grams make writers' voice convincing and authoritative in research reporting. As in the case of anticipatory *it*-patterns followed by evaluative adjectives, these grams express epistemic evaluations (and thus reflect committed authors) or attitudinal/modality meanings (detached stances), particularly in the Introductions and Discussions of the research articles, helping writers establish convivial writer/reader relationships for the purpose of research selling:

> What this example demonstrates is the importance of taking context into account when analysing images and, particularly, examining the pragmatic links between shots. (L1 English, literature)
>
> The study also confirms the importance of perceiving positive emotions of hope, solidarity and trust in the social climate as a form of overcoming the impact of a collective trauma. (L2 English, sociology)
>
> Con esta investigación hemos pretendido poner de manifiesto *la importancia de* [*the importance of*] asignar una marca comercial a los productos, por cuanto que dicha marca puede condicionar las percepciones de los consumidores respecto a los atributos del producto y la utilidad global que éste le proporciona. (L1 Spanish, business management)

Grams embedding anticipatory *it*-constructions followed by evaluative adjectives (e.g. *it is important to*, *important to note*) perform the function of aligning with

readers, as they serve to highlight the main claims reported in the article and by this means engage readers in a similar line of thought. Again, these grams recur in the Discussion/Conclusion sections of the texts, which corroborates that these rhetorical sections are not simply information-oriented but also highly dialogic and interactive. Aligning with readers is also conveyed by the high-frequency gram *should be noted*, which occurs throughout the rhetorical sections of the articles but above all in the Discussions/Conclusions. This gram performs pragmatically in the following respects. In Introductions it explicitly indicates the research gap (e.g. *It should be noted, however, that Wendel did not actually investigate on-line planning and his proposal is, therefore speculative*), while in Discussions it helps writers underscore their main claims (e.g. *It should be noted that a tiny fraction of all workers, those who have never been employed but who nevertheless would like a job now, would not have a reported industry*). The equivalent gram is found in the L1 Spanish subset of texts (e.g. *hay que tener en cuenta que [it should be noted that] una parte de ellos se convertirá en verdaderos positivos*). As argued by Hyland (2005, p. 8) and also earlier in this volume, the phraseology of contemporary discourse does not only perform rhetorically on the autonomous plane (i.e. the information-oriented) but also on the interactive plane (i.e. participants-oriented).

Argumentation, Intellectual Styles and Evolving Dialogic Spaces

In Chapter 2 it was argued that the process of discoursal nativization or hybridization of scientific English recalls Berns's general observation (1995, p. 6) that non-native English speakers make use of the English lexicogrammar but 'maintain conventions of the native language and culture' when composing texts. In the case of contemporary scientific discourse the previous sections of this chapter have illustrated homogeneous patterns, with preferred phraseological units across languages and cultural contexts. Also relying on the n-gram search, this section explores the argumentative structure of the texts to discuss the impact of the native culture in the L2 English texts.

In constructing argumentation, the three subcorpora primarily draw upon structural patterns expressing addition (*in addition to*), exemplification (*for example the, such as the*), alternatives ((*on*) *the one hand, the other hand*), paraphrasing (*in other words*) and causal markers. The latter set of markers can be further divided into means-end (*in order to*), cause-effect (*due to, because of the*) and reason-result (*as a result, as a consequence*) markers. The n-gram search further indicates that discourse level argumentation is primarily constructed upon causal markers in the case of the L1 and L2 English texts and transition markers in the case of the L1 Spanish texts, as explained below.

Of all discourse organizing grams in the L1 English texts, causal markers show the higher frequencies in the rank of 3-grams, with *in order to, as a result, due to the* and *because of the*. Of all discourse organizing grams in the L2 English texts,

causal markers *in order to, due to the* score the highest frequencies, followed by (*on*) *the other hand* and transition pattern *with respect to*. In the two subsets of texts the dispersion plot indicates that causal grams are evenly distributed throughout the texts but mostly recur in Introductions and Discussions. As shown in the examples below, causal grams occur when writers indicate the goals of the study, provide the rationale for the methodological procedures in Methods sections, introduce commentary of results or serve to acknowledge limitations:

> In order to determine the ecological outcomes of different inflows, volumes and inundation areas of the floodplain wetland need to be calculated. (L1 English, geology)
>
> [. . .] these were forms that were seen to play a key role in transition due to the conditions of the labour market against a background of globalization. (L1 English, sociology)
>
> In order to investigate the extent to which intrafirm diffusion can improve the analysis of the impact of new technologies on productivity, we employ a dataset that [. . .]. (L2 English, business management)
>
> Because the administration of justice rests in the hands of the very person who has committed the outrage, no redress is obtainable through established institutions. As a result, the hero takes matters into his own hands. (L2 English, literature)

In the L1 Spanish texts causal grams do not score as higher in the rank as they do in the L1 English subset. Instead, transition markers *con respecto a* [*with regard to*] and *en cuanto a* [*as far as*] and concessive *a pesar de* [*although*] occupy the top positions in the n-gram rank. Qualitatively, two main observations can be made with regard to convergences and divergences. First, the Spanish writers' preference for phraseological units explicitly indicating transition from one topic to another might indicate a possible L1 Spanish transfer into the L2 English texts, and might even suggest that writing in an additional language does not adhere to the well-known Anglophone use of a topic sentence in paragraph construction. In the L2 English texts, the use of the gram *with respect to* is the preferred formula for signposting shift (transition) of topic. Second, concessive phrases appear to be a distinctive phraseological preference of the L1 Spanish texts, as they do not occur in any of the two sets of English texts. The concessive gram *a pesar de* plays a key role in restricting the scope of the claims and acknowledging provisionality of the claims made in Conclusion sections:

> *A pesar de que los datos* de que disponemos en la actualidad *indican que* [*although our data indicate that*] los hidratos de gas *poseen potencial como para convertirse* en una formidable fuente de energía alternativa [*show potential to become . . .*], *su desarrollo todavía se encuentra en una etapa muy temprana* [*their development is still at an early stage*]. (L1 Spanish, earth sciences)

Close analysis of the way arguments are constructed further shows that the L1 English texts display a more simplified syntax than the other two subsets of texts. As illustrated below, the L1 English scientists use a linear intellectual style and display an overtly critical stance. In Introductions, causal grams *as a result* and *because of the*, which are used for providing reasoning in the critical review of the literature and in doing so create a research gap, are generally accompanied by simplified clausal elaboration and a straightforward style:

> Traditional ingredients (e.g., vitamins, minerals) used to fortify functional foods are widely recognized and accepted by consumers as being healthy. However, novel functional ingredients (e.g., probiotics, prebiotics) are less familiar to consumers. As a result, little is known about the consumer acceptability of these unique ingredients. (L1 English, food technology)

In Discussions/Conclusions the L1 English writers withhold full commitment to the claims they make in the article for persuasion purposes. Reasoning n-grams lead to statements of conclusions. In addition, they tend to be accompanied in their co-text by *we* self-mentions, evaluative lexis and modalized markers (namely, probability modals and epistemic modals). The extract below illustrates how the L1 English scientists easily take for granted the readers' consensus while adhering to simplified clausal elaboration and a straightforward style:

> Our study showed that the patients' compliance and quality of recorded data is identical for both methods of data capture. We recommend electronic capture in future because of the advantages of this approach. For example, it would lessen the risk of input errors because there is no need for transcription (i.e. there is no need to make a re-entry of those data on a computer). Although it is not shown conclusively here, we believe that electronic capture might be a considerable time-saving procedure in future. (L1 English, oncology)

Conversely, the L1 Spanish texts are syntactically dense, featuring the digressive style of Romance languages (Gentil 2011). Syntactic elaboration in Spanish is constructed upon coordination, subordination and complementation constructions. Distinctness is based on style preferences such as long sentences, verbosity and wordiness. Convoluted argumentation and a formal style yield verbosity and wordiness. The extract below, a one-sentence extract, contains a complement clause, two causal subordinate clauses, a finite *–ing* clause and two relative clauses. It should be noted here that overall average frequencies indicate a significant overuse of grams embedding relative clauses in the Spanish texts (35.98 per 1,000,000 words) compared to the two subsets of English texts (0.89 in the L1 English subset and 3.20 in the L2 English subset). Clearly, the differing frequencies across subcorpora should also be attributed to the fact

that Spanish is an inflected language and therefore shows greater variation of structural patterns containing relative pronouns (e.g. *en el que, en los que, en la que* correspond in English to *in which the*):

> *El hecho de que* [*the fact that the*] Internet Explorer tenga una posición de monopolio en los clientes lo convierte en punto de referencia a la hora de acceder a una página Web y, *dado que* [*since*] en muchas ocasiones ignora los estándares de diseño, perjudica a la accesibilidad en el diseño de páginas Web, *porque* [*because*] algunas soluciones propuestas en las normas más novedosas del W3C no son de aplicación para el navegador de Microsoft, *debiendo* [*making it necessary*] buscar una solución alternativa *que* [*that*] satisfaga a este navegador y a la norma, con la consecuente pérdida de tiempo *que* [*that*] este hecho conlleva. (L1 Spanish, information science)

Interestingly, the overall argumentative flow of the L2 Spanish texts shows that the textual rendering very much resembles the syntactic digressiveness of the L1 Spanish subset of texts. Stylistically, wordiness and abundant clausal elaboration might then be considered a possible L1 to L2 transfer. The extract below readily brings to the fore the way Spanish scholars retain some L1 Spanish syntactic and stylistic traits even if they use the same phraseological grams expressing causality as those used by the scholars in Anglophone contexts. On a related manner, the following example recalls Kerans' (2002) claims on reported misunderstandings caused by the particular thematic progression in L2 English texts written by Spanish scientists and Mungra and Webber's (2010) study of peer reviewers' criticisms on the verbosity and repetition in the non-native English-speaking scholarly contributions (cf. also discussion in Chapters 5 and 6):

> It appears [*complementation* →] that the Spanish scientific community in the area of experimental social sciences consider it unconventional to criticise the work of previous authors. This may be due to the fact [*complementation* →] that the reduced number of members [*reduced relative clause* →] belonging to this community makes it unnecessary for the Spanish researcher [to-*inf. clause* →] to establish a niche, [*subordination* →] whereas this practice seems to be quite frequent among the members of the international academic community, [*subordination* →] as there is more competitiveness [to-*inf. clause* →] to publish [coordination →] and consequently a greater need [to-*inf. clause* →] to justify their work. (L2 English, applied linguistics)

Compared to the L1 English subset of texts, the L2 English texts show convergence regarding the preferred patterns and discourse uses of standardized phraseology but divergence in terms of syntactic elaboration and formal argumentative style, indicating that 'two sets of values are simultaneously at work in the writing of a scientific report: those common to the

academic community and those held in esteem in the writer's national culture' (Mauranen 1992, p. 239). The resulting hybridity of the L2 English texts has also claimed to be the case of other non-Anglophone scholars (e.g. Mauranen with Finnish, Clyne with Germans, Duszak with Polish, Giannoni with Italians or Bennett with Portuguese scholars, to name a few), and confirms that differences between L1 and L2 English texts lie in differing culture-specific intellectual styles and scholarly traditions. Indeed, 'the discourse level of language is inseparable from cultural behaviour and that, except in individuals with a high degree of biculturalism as well as bilingualism, this will determine a great deal of inter-lingual transfer at the discourse level' (Clyne 1996, p. 6).

The divergent intellectual styles of the SERAC subsets illustrated above make necessary a brief discussion on intersubjective positioning and different heteroglossic modes of expression, heteroglossic engagement vs heteroglossic disengagement modes of expression (White 2003). As discussed below, these modes are intrinsically related to the construction of 'evolving dialogic spaces' (Pérez-Llantada 2011, pp. 40–2), in the Introduction sections and, above all, in the Discussion/Conclusion sections of the texts.

The very straightforward style of the L1 English texts can be roughly defined as creating a convivial intersubjective positioning. As in the extract below, writers combine evaluation with modalization to underscore the validity of the research findings – even if they are provisional in nature – hence making the discourse persuasive. Initially, the authorial voice is modalized by the epistemic marker *appears* but, as the text progresses, the argumentative flow becomes dialogically contractive, featured by linguistic markers such as first person *we*-pronouns as self-mentions and inclusive pronouns, evaluative lexis and modalized markers such as probability modals and adverbs occurring only in dependent clauses but not in the independent ones. These contractive resources close the space for dialogism and implicitly suggest that the writers construct their readership as sharing similar viewpoints, that is, as potentially consenting. This is an instance of what White (2003, p. 262) calls a 'heteroglossic disengagement' mode of expression:

> There appears to be some evidence of the findings for his expressive prosodic skills in a small amount of conversational data. We have also shown how the CCC indicates a measure of pragmatic deficit, and the role that prosodic skills may play in this. Prosodic deficit is seldom addressed by speech and language therapists (despite the fact that overt prosodic atypicality such as Adam's may have an impact on his social acceptance). However, the PEPS-C offers a way of assigning prosodic impairment to a specific level/mode of processing, and in conjunction with the CCC it is possible to identify aspects of communication that may be affected as a result of prosodic deficit. (L1 English, applied linguistics)

In contrast to the L1 English texts, the L1 Spanish texts consistently use impersonal syntactic constructions, even if authors occasionally include evaluative statements. Unlike the L1 English writers, impersonality and facelessness in the expression of critical stance is accompanied by abundant dialogically expansive resources such as inanimate subjects, impersonal anticipatory *it*-patterns and probability and possibility markers. By this means, the L1 Spanish writers open up the space for dialogism, suggesting that their readers' construal is one potentially dissenting. Cyclicity in the argumentation of ideas – moving from a heteroglossically engagement mode of expression to a heteroglossically disengagement mode of expression and back to a heteroglossically engagement mode of expression at the very end of the text – instantiates once again the digressive argumentative style of Spanish scholarly prose:

> *A pesar de* [*In spite of*] las limitaciones del estudio, el trabajo ofrece un marco de dimensiones de flexibilidad de la cadena de suministro que *podría utilizarse* [*might be used*] de base de partida para futuros estudios. Por ejemplo, *sería útil analizar* [*it would be useful to analyse*] qué dimensiones de flexibilidad constituyen las mejores respuestas a las incertidumbres del entorno en distintos sectores de actividad. Además, *el trabajo* se centra en la flexibilidad de la cadena de suministro y *no ha tenido en cuenta* [*the study has disregarded*] algunas de las dimensiones básicas de flexibilidad en el área de operaciones (por ejemplo, flexibilidad de máquina o la de mano de obra), *las cuales también pueden influir positivamente* [*which can also exert a positive influence*] en el rendimiento de la empresa. Futuras investigaciones podrían desarrollar [*further research might develop*] también medidas objetivas de las dimensiones de flexibilidad de la cadena de suministro, *ya que una possible limitación de este trabajo sea su dependencia de datos basados en* percepciones de directivos [*since a possible limitation of this work is its dependence on data based on*] [. . .]. (L1 Spanish, mechanical engineering)

In moving from convivial to deferential intersubjective positionings the Spanish writers writing in English construct a hybrid dialogic space for writer/reader interaction, which merges a heteroglossic engagement with a heteroglossic disengagement mode of expression. This distinctive intersubjective positioning places authors as intellectually able but also as showing respect towards the 'authority', namely, their disciplinary audience or community of practice. As shown below, the L2 English texts display a pragmatic blend of detachment/commitment towards propositions. At the beginning of the extract, a *we*-pronoun self-mention is used to underscore centrality of findings, but as the text progresses the writers use dialogically expansive devices such as oblique *we*-pronoun forms, impersonal subject patterns, probability modals and conditional markers that open up the space for dialogism, constructing a heteroglossic engagement mode of expression. At the end of the Conclusion

section, the blend of evidential, possibility and epistemic modality markers (e.g. *evidence*, *can*, *could*) implies that writers anticipate possible criticism on the part of the readership. In doing so, the Spanish scholars conceive their readers as potentially dissenting:

> Although we focus on mature product markets in which standards battles are less crucial, empirically disentangling this alternative explanation is not easy. Hence, the interpretation of our findings should be made with caution. Theoretically our framework would clearly benefit from a deeper integration of our strategic positioning approach with the transaction costs approach. Ideally, one should be able to predict simultaneously the choice of the governance structure and the extent to which each governance structure is used. Finally, as far as it concerns the generality of our findings, one could easily contend that they are idiosyncratic to the chemical industry. As a partial defense to our work, we could point to empirical evidence showing that industries with large licensing activity, such as electronics, biotechnology, and semiconductors, are also those that have sufficiently well-functioning markets for technology (Arora et al. 2001). However, only future research can demonstrate whether our findings are industry specific or more generally applicable. (L2 English)

The intersubjective positioning of the L2 English texts is indicative that the Spanish scholars retain part of their culture-specific intellectual style when they write in English as an additional language. In contrast to their L1 English counterparts, the Spanish writers writing in English acknowledge more vulnerability to criticism and opt for less visible intersubjective stances. This positioning is also the case of Polish scholars, who tend to adopt a defensive position and anticipate criticism (Duszak 1994). Yakhontova (2002, p. 231) likewise comments that '[Ukrainian and Russian] scholars writing in a nonnative language may even intuitively seek a certain "rhetorical compromise" and choose "softened", less frustrating strategies'. These cohorts of L2 English scientists bring to the fore the social dimension of the 'publish or perish' dilemma as their intersubjective stances suggest that writing in English for transnational research communication instantiates 'discoursal variation across the centre-periphery continuum' (Giannoni 2008, p. 98). From a broader social linguistics perspective, the particular processes of discursive borrowing and blending reported in this chapter stress the importance to reflect on discourse and on the conception of language as 'fully attached to "other stuff": to social relations, cultural models, power and politics, perspectives on experience, values and attitudes, as well as things and places in the world' (Gee 1996, p. vii).

Chapter 5

Disciplinary Practices and Procedures Within Research Sites

An Ethnographic Approach to Science Dissemination

We assumed at the outset of this volume that scientific discourse is a socially situated activity. It involves consensual decisions in constructing knowledge and is dependent on the ontological values and discursive practices of the disciplinary/sub-disciplinary community. Complementing the corpus analysis of Chapter 4, this chapter seeks to compare similarities and differences in the written discourse produced by scholars from a North-American-based research site and scholars from a non-English-speaking research site, scholars who therefore use English as L2 for scientific communication. Drawing on ethnographic and textographic frameworks (Hymes 1972, Prior 1998, Swales 1998; see also Lincoln Guba 1985 on naturalistic enquiry and Taylor 2002 on micro-scale social interaction), the chapter explores the actual social scenarios where scientific discourse is produced, the subjects (scientists) and their relation to their social context. As Kuhn (1962, p. 210) puts it, 'scientific knowledge, like language, is intrinsically the common property of a group or else nothing at all. To understand it we shall need to know the special characteristics of the groups that create and use it'.

Drawing inspiration from previous ethnographic work on different cultural contexts (e.g. Swales 1998 on North-American academics; J. Flowerdew 1999, 2000 on Hong Kong scholars; Curry and Lillis 2004, on Hungarian, Slovakian and Spanish scholars; Cooke and Birch-Becaas 2008 on French scholars; and St John 1987, Fernández-Polo and Cal-Varela 2009 and Pérez-Llantada et al. 2011 on Spanish scholars), this chapter reports on interview-based protocols with a representative group of Spanish academics and an equally representative group of scholars from a North-American context. The main goals of the protocols were the following. The first one was to find out the scholars' attitudes towards research production in the globalizing landscape, with a special focus on the role of ELF for scientific dissemination. The second was to enquire into the scientists' discourse practices in an English-medium research world, into the specific research procedures of sub-disciplinary communities, and into the extent to which the nature of knowledge affects the actual discourse practices

of the scholars. The third goal was to analyse the scientists' awareness of the standard discourse and rhetorical conventions of scientific English. In addition, the protocols sought to get to know the processes of acquisition of academic literacies within the scientists' community practices and procedures for interaction, as well as the scientists' perceptions of the most problematic aspects of writing up science and presenting it in English to both English-native and non-native peer scientists. This last goal further aimed at assessing the possible reasons and effects of these linguistic advantages/disadvantages and at identifying pedagogically oriented ways of approaching English language needs.

The dataset for this study comprised 80 qualitative semi-structured face to face interviews of 40 North-American-based academics at the University of Michigan (US) (numbered #1-#40) and 40 Spanish academics at the University of Zaragoza (Spain) (numbered #41-#80). These universities were selected since they are relatively similar in size, with approximately 40,000 students and 3,000 faculty members. University affiliation was a key parameter for the selection of scholars since this was deemed to guarantee familiarity with academic and research activities. For collecting a representative, stratified population, scholars were selected in terms of disciplinary domain and in terms of seniority. This distribution was similar in the two institutional contexts. Accordingly, each set of 40 included 20 junior and 20 senior scholars. Each subset of 20 scholars was representative of the 4 major disciplinary domains and included 5 scholars in the Physical Sciences and Engineering, 5 in the Humanities and Arts, 5 in Biological and Health Sciences and 5 in the Social Sciences and Education. The parameter of disciplinary domain was expected to retrieve variation across the different scholarly tribes and not across cultural contexts. Varying levels of seniority in academia were expected to provide gained insights into past and present discourse practices and processes of disciplinary enculturation.

In addition, the scholars' availability and willingness to cooperate in this study were key factors in selecting the interviewees. Efforts were also made to match the scholars according to sub-disciplinary specialization and to match their disciplinary profile with those represented in SERAC 2.0. The subjects categorized as senior scholars in the two university contexts were homogeneous in the following respects: either as full professors or associate professors, they had at least 20 years experience in both research publishing and academic teaching at university level; they all had a considerable number of publications in impact-factor English-medium journals and they actively collaborated in research teams. The subjects categorized as junior scholars in the two contexts were also a homogeneous sample since they all had less than ten years experience in research publishing and academic teaching activities; they were assistant teachers, research assistants and/or research associates; they had an average of between 5–10 research publications in impact-factor English-medium journals and national journals, and they actively collaborated in research teams. A sample of subjects representing an intermediate

category (e.g. some nearer the senior group, others closer to the sample of junior scholars, some having experience in academic teaching activities while not in research publishing and vice versa) was discarded because of the lack of uniformity of the subjects.

The interview protocols were conducted in English (in the UM context) and in Spanish (in the UZ context) over three-week periods during two consecutive summers in the former context, and at the end of the academic semesters (January/May) during two consecutive years in the case of the latter context. The same protocol was used in all the interviews. The semi-structured format facilitated enquiry into specific aspects raised by each individual informant. Each interview lasted around 40–45 minutes per scholar, which made approximately 54 hours of recordings. As in Pérez-Llantada et al. (2011), the interviews were digitally recorded with the permission of the scholars and were also transcribed so as to allow subsequent detailed content analysis.

Questions for the interviews were roughly divided into three main sets. The first set of questions enquired into the scientists' conceptions of science dissemination, and about the nature and epistemology of knowledge of their particular sub-disciplinary field set against the broad concept of 'science'. Questions also focused on the importance of disseminating scientific knowledge both locally and internationally, and on the increasing predominance of English in scientific communication to reach the international stage. The specific questions were the following:

- Can you briefly describe your research activities and explain the reasons why you disseminate science?
- How would you describe the nature of your discipline? What are the most important ways for science dissemination in your field?
- Would you say that the globalization phenomenon is affecting your academic activities? If so, to what extent?
- What do you think about the use of English as the international language for scientific communication?

The second set of questions enquired into the subjects' actual discourse practices and procedures for interaction within their sub-disciplinary community. This set of questions also sought further clarification on the scientists' use of research genres and on their process of enculturation in academic literacies. This second set of questions was similar to that used in Pérez-Llantada et al. (2011) so as to corroborate previous claims with a larger sample of scholars and compare findings across two cultural contexts:

- Is scientific output an individual or a collaborative task?
- Can you tell me how you learned how to write scientific prose? Did you find any difficulty in writing it?

- Which part of a scientific paper is for you generally the most difficult part to write (e.g. Discussion, Introduction, Results, conceptual part or theoretical part?) Why?
- Do you normally rely on colleagues to help revise the paper? In what ways, yes? In what ways, no? Is this useful and, if so, why?
- What kind of comments do you get from journal editors/reviewers? What are your perceptions of journal editors/reviewers' comments on your papers?

The third set of questions focused on the scientists' attitudes about the role of English as the lingua franca for scientific communication, both in written and spoken genres. It also raised language issues related to Anglophone normative models and ELF, with a focus on finding out possible linguistic advantages/disadvantages among the scholars of the non-Anglophone (peripheral) context. The specific questions included in this part of the interview, also found in Pérez-Llantada et al. (2011), were the following:

- Does English have any advantages for carrying out your academic activities with international colleagues?
- Do you think that the dominance of English gives an advantage to native speakers?
- Would you say that the dominance of English gives a disadvantage to non-native scholars? Is this disadvantage unjust to non-native scholars?
- Have you ever noticed limitations of language use in non-native texts and if so, what kind of advice have you given to the authors?
- While speaking in English at a conference or in public, what strategies do you use for interacting with them?
- When you ask questions to non-native speakers at a conference, have you ever noticed that they have limitations in the use of the language? If so, which ones?

The most recurrent themes of the interviews are summarized below.

On the Value and Epistemology of Scientific Knowledge Production

Scientific communication was unanimously described by both UM and UZ, senior and junior, as the main means for disseminating scientific knowledge, furthering progress in the disciplinary field and 'having an intellectual conversation with people working on related topics' (scholar #22). Many scholars also referred to personal satisfaction, interest in going more deeply into the knowledge of the field, intellectual curiosity and individual challenges in the sense of having to identify truly original research:

> Without publishing, nobody knows what I'm doing, I can't get promotion, I can't get recognition, nobody knows what we've found. We're trying to move the field ahead, I need to be able to say this is what we found so that others can evaluate it [. . .] but, sure, at the basic level I have to publish to establish credibility. (scholar #2)

The overall impression drawn was one of collegial, non-competitive, scientific exchange. By way of illustration, the interviewer's reference to a paper that received 1,500 citations merely prompted its author to comment 'This is the most popular' (scholar #3). Senior UZ scholar #52 noted the importance of gaining expertise in the field of investigation – 'my best publications have been written and published after I became a full professor'. Succinctly stating that 'publication is the culmination of research work, [you're] measured, valued, paid, promoted' (senior scholar #44) only very few scholars referred to reasons of prestige and recognition in the community and in the international sphere.

Promotion arose as a secondary motivating reason for having a very strong research record. The number of publications was the main criterion for promotion in the merit system, a requirement in the tenure process and necessary for career advancement. The 'publish (in English) or perish' dilemma was, as expected, much more deeply felt by the non-native English scholars at UZ, who often noted that the individual pace of publication has increased dramatically compared, for instance, to that in the 1970s and 1980s (scholar #51). Promotion was indeed one of the most motivating factors among the junior scientists. Junior scholars, particularly those at the UZ, considered scientific publishing to be an obligation imposed by the universities for the sake of institutional prestige and quality assurance: 'publishing is a duty, not voluntary, it's part of university teachers' activities and together with teaching it reflects your research activities and is therefore a merit for tenure track' (scholar #78).

The senior scholars in the two cultural contexts further mentioned institutional reasons and explicitly referred to universities as 'manufacturers of knowledge', evoking Knorr-Cetina's (1981) words. While noticeably unperceived by the junior scholars in the two cultural contexts, the seniors recurrently stated that the role of universities is to develop knowledge. Scientific communication was regarded not only as a necessary record of the advances of the discipline but also a way of disseminating new knowledge both intranationally and transnationally. As scholar #31 stated, 'the role of the university is to develop knowledge and to impart that to the students and the public at large, and particularly to the professional groups that are doing similar kinds of investigation'.

A remarkable contrast between the two cultural contexts was the UZ scientists' increasing concern for gaining visibility in the international stage.

This lends support to previous studies on non-Anglophone scholars' interest in publishing in English to be able to participate in core/global communities (e.g. Medgyes and Kaplan 1992, Duszak and Lewkowicz 2008, Giannoni 2008, El Malik and Nesi 2008). In the UZ seniors' views, publishing in local, national-based journals in periphery countries involved a much more restricted knowledge dissemination – 'we realized we were not cited in important journals' (scholar #63). In addition, publishing good-quality research internationally was seen as a merit for obtaining projects, getting known by editorial boards and, as a result, getting other publications published in those journals – 'if those abroad don't know you, they just don't care about you' (scholar #43).

Questions on science dissemination in scholarly journals unanimously confirmed the predominance of core/global, internationally recognized, English-medium publications, 'in the sense that they accept submissions from all over the world' (scholar #6). *Science*, *Cell* and *Nature* were top of the rank in the sciences and were described as 'the ones of most general interest and the hardest to get into' (scholar #22) and 'important for advancing the field' (scholar #4). *Science Biochemistry*, *Cell Biochemistry* and *Nature Biochemistry* were also among the most cited by the UM and UZ scholars. Across disciplinary fields all highly regarded journals that the scholars mentioned (*Journal of Cell Biology*, *Journal of Biochemistry*, *Journal of Bacteriology*, etc.) were also considered stable, solid, reliable sources. In the social sciences, *American Economic Review*, *Journal of Marketing Research*, *Journal of Law Economics*, *Journal of Political Economy*, *Journal of Business Communication*, all North-American based, and cited as top journals in the SCI and JCR.

The scholars' references to inclusion of journals in citation indexes in the experimental fields showed their awareness of the use of indicators of scientific production across knowledge-intensive economies and, at a small scale, across university and research institutions. As a scholar #43 remarked, 'whether we like it or not, only impact factor is valued to measure the quality of publications'. In striking contrast, the scholars in the humanities in the two cultural contexts showed very different views on scientific research dissemination. They reported that, until recently, they mainly relied on individual preferences when choosing journals for disseminating their research. In general, until recently, they had not been very much interested in high core/global, internationally recognized, impact factor publications. The overall impression from the protocols was that they indeed were less perceptive of the growing institutional pressure to publish and of issues of transferability and accountability of knowledge production and, more broadly, of the growing marketization of scientific knowledge.

International competition was specifically noted as a key motivating factor for the manufacture of knowledge, particularly in some research fields such as biochemistry, immunology or cell biology, marketing, economics and systems

engineering in the two university settings. For both senior and junior scholars at UZ, English-medium publication guarantees research transferability, as current research policies advocate, accountability and eventual market competitiveness with other knowledge-intensive, technologically more advanced economies such as the United States, China or Japan:

> Publishing internationally is a means of being in the market. The US and Japan have consolidated technology and direct manufacturing. If we don't make any scientific contributions we are not visible. (scholar #50)
>
> My field is very competitive and publishing is very important, the more the better. It is therefore advisable to publish in high impact factor journals. It's a daily struggle. (scholar #62)

Issues of knowledge making and sharing rendered distinctive epistemological beliefs across academic tribes. These beliefs, though, were strikingly similar in the two cultural contexts, revealing well-defined sub-disciplinary territories. The physical scientists were more focused on verifying how atomistic mechanisms evolve, maintain and adapt, and, as explained by scholar #7, on how universal biological processes function and why particular mechanisms can intrinsically make those processes worse or better. The scholars in the biomedical field, conducting both basic and clinical science, referred to their pragmatic interest in solving clinical questions and finding heuristic approaches (manifested in therapies and specific treatments for illnesses) for the advancement of social welfare. The social scientists draw upon multidisciplinary theories and share a common belief in the utilitarianism and pragmatism of their field as well as a particular concern with professional practice. The scholars in the humanities, the domain of abstract entities, described their disciplinary fields as one involving interpretation and most often, lack of consensus. The extent of truth claims usually stemmed from lack of consensus or value-laden premises. Accuracy in scientific reporting was related to reproducibility of the experimentation in the case of the biomedical and physical fields, applicability in the social sciences fields, practicality in the engineering subfield and interpretability and intellectual dialectic in the humanities.

Except for some of the humanities scholars, the interviewees reflected a number of criteria in defining the nature of new knowledge – the latter interestingly judged by the scholars not only in quantitative but also qualitative terms. Objective research reporting was said to open up a space for 'confirmability', that is, the capacity to establish and corroborate the validity of the new knowledge by other peer scholars. Credibility and reliability of results were more accurately defined as 'dependability' of the research context, which explained the scholars' reported interest in qualifying new research findings and stating provisionality of facts and, therefore, limitations overtly. This

evoked the dominant cultural logic of relativism of the postmodern times (cf. Habermas 1984, Lyotard 1984), as stated below:

> An important step in advancing science without coming out and saying something with your name on it and having to defend that to reviewers and to the public at large. Some things may turn out to be wrong later, but it's there, together with your name on it, and you want to make sure that it's to the best of your knowledge, you know, what you think is real. (junior scholar #7)
>
> If you haven't got an explanation you might admit you don't have an explanation before somebody says have you got an explanation? I'm suspicious of analysts who never have a trash bin of things they don't know what to do, especially graduate students. You're forcing things into categories. I think it's perfectly reasonable to say 5 per cent, 10 per cent, that's honesty. (senior scholar #10)

In relation to international collaboration the two sets of scholars regarded scientific research production within a core centre as parochial and non-generalizable because local research lacks the global perspective. Other effects noticed were increasingly international undergraduate populations at university and, culturally, the fact of having a better appreciation of people from other countries and removing prejudices. The scholars in the two contexts explained that internationalization allows richer and more challenging communication among scholars from different nations:

> Science has always been a very global enterprise. And long before people worried about globalization, scientists from different countries were in one of the few professions where it was relatively easy for somebody from one country could go and work in another country with people with very specialized knowledge. (senior scholar #5)

References to the nature of scientific knowledge as multidisciplinary also recurred in relation to international collaboration. The latter was reported to facilitate the way scientists currently communicate and advance such knowledge. In addition, research networks were justified by the intricacy of complex systems, processes and linkages underpinning the nature of knowledge itself – the clearest example being the human genome, a 13-year project which required collaboration of the United States, United Kingdom, Japan, France, Germany and China, among others, and involved researchers in physics, chemistry, biology engineering, ethics and informatics. As scholar #44 succinctly puts it, 'nowadays science is more complex and requires collaboration'. This, again, was more deeply felt among the scholars researching in experimental field than among the scholars in the humanities.

Core/Peripheral Centres and an 'English-Only' Research World

International cooperation motivated questions related to globalization of research activities and, more specifically, to the use of ELF for scientific communication. What follows recalls, in a sense, Berns's (1995, p. 9) claims on the use of English in the outer/expanding and, above all, expanding circles (see Chapter 2). In the particular case of academia, internationalization raised issues on an 'English-only' research world, as explained below.

In the two cultural contexts, the scholars all agreed on the importance of a common language for scientific exchange and knowledge dissemination. They were both aware that publication in internationally recognized, impact-factor English-medium journals is not restricted to Anglophone scholars in the core centres, but open to other international scientists in peripheral centres elsewhere. Despite being US-based, the editorial boards of these journals were reported to be very diverse in terms of global representation. All the UM interviewees were either editors (the seniors) or belonged to editorial boards of these journals (both seniors and juniors). All the senior UZ scholars stated that they actively collaborated in international editorial boards and refereeing processes. But noticeably, while the senior UM scholars did not refer to difficulties in publishing in these journals, their senior UZ counterparts often referred to certain rejection rates when gaining visibility in the international context and pointed out the importance of selling research appropriately: 'If you are capable of promoting your research, they publish it' (scholar #44). No commentaries of this kind were made by the UM scholars.

On a related manner, the implicit meaning of core vs periphery was also noticed by senior scholar #51, who stated that '[publishing] internationally is an issue *in crescendo*, it also has to do with moving out of Spain and publishing abroad. Of course publishing in English is important so that we can compare ourselves with others and see how far we are from them'. The physical, biological and social scientists in the two institutions were all aware that the 'pressure to publish is increasing and will keep on increasing' (scholar #73), mainly due to accountability reasons and the current research-transferability market. These observations indirectly echoed the current geopolitical and economic reasons sustaining the predominance of big geopolitical and economic regions like the United States or Japan vis-à-vis peripheral ones, as discussed in an earlier chapter.

When referring to the use of English as a lingua franca of science, the UM scientists specifically mentioned that scholars from China, Japan and certainly Europe needed English as 'part of their toolkit' (senior UM scholar #31). Linguistic imperialism, understood here as the English hegemony in academic publishing (cf. Canagarajah 1996, 2002, Ammon 2001, 2006, Hamel 2007, for

instance) was only mentioned by one of the UM scholars, who noted that 'in academia I imperialistically expect to speak in English'. In general, while the native-English scholars initially felt at an advantage compared to non-native English speakers, they also felt at a relative disadvantage for not knowing or having been taught any foreign languages. At this point, though, the scholars readily acknowledged the predominance of English for knowledge dissemination and publication to the detriment of local languages, especially in Europe. While German and French had been the scientific languages in the pre-war period, they were gradually replaced by English as the language of scientific record, since European scientists moved to North-American universities and research institutions. As some of the UM and UZ scholars noted, the mobility of human resources for political reasons contributed to the shift of language in science.

The role of ELF was described as one that facilitates research dissemination and international collaboration across academics worldwide, particularly in terms of the number of people in the world that speak English. Salient among the scholars' perceptions of ELF and globalization were the comments both the native and non-native UM and UZ scholars made on feasible linguistic reasons why English is at present the dominant language for academic and research communication worldwide. ELF was specifically compared to Latin in the Middle Ages in its role as the universal language for scientific communication. UZ scholars #48 and #50 held the view that English was an easy language to learn compared to the inflected grammars of Indo-European languages like German, or the writing systems of Asian languages like Chinese or Japanese. As an anecdotal aspect, one of the scholars even mentioned Mark Twain's *The Awful German Language* (1880) as a succinct satirical explanation of the difficulty of German.

English was described as not having the lexical rigidity of other languages such as German, for instance, because it has both a Germanic and Latin background and therefore has several words for one single term – hence it provides subtlety of meaning and avoids ambiguity. English was also considered as lexically restricted, allowing fluency with limited vocabulary knowledge. English grammar was described as a facilitating feature, with declarative word order settling the clause elements (also like Chinese and other East Asian languages), minimal inflection and with very few grammatical irregularities compared to other West Germanic languages (German or Dutch) or Romance languages such as French, Spanish, Portuguese, Italian, Romanian and French which have nominal, adjectival and verbal inflections. German, Spanish, Portuguese and Italian have less rigid clausal word order, and some of these languages allow subject-verb inversion. Another flexible feature of English was its neutral degree of formality conveyed by the lack of distinction between formal and informal second person which, for instance, is a dialectal difference of South-American Spanish that does not apply to Peninsular Spanish. Grammatical

comparisons across languages also paved the way to explicit observations on different world Englishes, confirming Graddol's (1997) view on English borrowing culture-specific traits of non-native English speakers worldwide. This linguistic variability was sensibly seen as a sign of rich diversity rather than as an imperialistic endeavour – as UM scholar #32 put it, English 'is a language that isn't really owned by any country if we take the world English perspective'.

A concomitant factor noted by the UZ scholars was the fact that in the Spanish context the national merit system was established in 1989 for research activity evaluation over a six-year time period (*sexenios*). This, the scholars stated, conferred greater recognition to publication in impact-factor English-medium rather than Spanish journals (cf. Curry and Lillis 2004, Moreno 2010). Regardless of their disciplinary specialization, for all the senior UZ scholars this policy involved a much greater effort not simply linguistically, but rather on the grounds of producing good-quality, internationally recognized research:

> When the *sexenios* started, Spanish journals were not valued because they were not on the impact-factor list. [. . .] This meant a greater effort because these international journals are very demanding and they always ask me to revise and rewrite the paper but eventually you get the merit. (scholar #63)

Together with political and economic reasons, other local policies might also have contributed to making scientific English a well-established lingua franca to date. The UZ scholars overwhelmingly referred to the 'publish in English or perish' motto. They reported that they published in Spanish very sporadically or not at all. The few Spanish contributions ranged from pedagogically oriented publications, popular science texts, invited contributions to national-based monographs or festschrifts to round tables and papers in national conference proceedings. As for the spoken mode, Spanish was only used in plenary talks addressing student audiences or general audiences (scholar #52). Essentially, reasons of promotion and international recognition as well as the Spanish merit system for research activity evaluation mentioned above appeared to create the scholars' need for publishing in English – 'we were not interested in that until the Spanish government set up the national evaluation agency' (UZ senior scholar #52). In their efforts to comply with this research policy regulation, the scholars reported that they have a decreasing interest in Spanish-based publications, even if these are supported by prestigious institutions such as the Spanish Royal Academy of Sciences or the Royal Academy of Spanish Language (Real Academia de la Lengua Española) (cf. also Chapter 7 this volume). As a result, as discussed in the following chapter, shifting to English for publication is gradually becoming a common journal policy for non-English-medium scientific publications elsewhere.

Finally, discussion on whether English as an instrument for scientific communication was advantageous or disadvantageous showed manifest

sensitivity towards multiculturalism and plurilingualism. The UM scholars readily acknowledged the advantage of being native speakers, enabling them not to have to spend time in translating papers, though having a common language was 'not completely fair' (scholar #7). The majority of the senior UM scholars defined the dominance of English as a 'linguistic barrier' involving not only studying English but also being proficient in it (scholar #31) and involving a 'huge disadvantage to non-native speakers' (scholar #22). Further remarks such as English being the dominant language for science dissemination 'certainly puts the (non-native English) world at a disadvantage' (scholar #4), a comment which certainly evoked current claims on linguistic imperialism (Canagarajah 1999, Ammon 2000, Hamel 2007). Contradictory views were observed, with some interviewees referring to the 'disadvantage to non-natives' 'but not unjust if we are to have a single language' (scholar #22) and others considering that initial disadvantages were overcome by advantages ('it's an extra hurdle [. . .] but once you reach a certain level of proficiency then I think that it isn't really a very big disadvantage', scholar #6). The issue of (un)fairness raised numerous concerns among the non-Anglophone scholars.

In the UZ context, the dominance of English was reported to entail both advantages and disadvantages, it required 'greater effort but worth the effort' (scholar #63). For scholar #31 it was a matter of efficiency, not of injustice. This would mean that scientific output, if regarded as a marketized object, would be greatly determined by the language spoken by the scholar – either the current lingua franca, English or the local language. The easier it is for a scholar to communicate research in English, the more productive the scholar is, as the quote below asserts. Conversely, the non-native English interviewees explained that they had to devote time both in learning the language and publishing in English:

> 'Is it efficient to have a lingua franca?' The answer is yes. Now, if everybody talked in their own language nobody would be disadvantaged relative to the other folks but you wouldn't have the extent of international communication that you now have. By the time people thought about Esperanto they've gone into English and they've gone into English primarily because of the dominance of the US economy in world trade, in world business. (scholar #78)

Only a few scholars showed a certain pragmatic resignation towards the instrumentality of the language at work – 'there is no choice' (scholar #71), 'it is just the way it is' (scholar 63). For others, such a disadvantage is easily overcome by 'getting out of the small circle and opening up to the world, getting to know other cultures and people and work at a completely different professional level' (scholar #44). In tune with the quote above from scholar #63, the UZ scholars, both juniors and seniors unanimously referred to the great effort involved in the drafting of manuscripts, above all because of their limitations in the richness of expression. Over time, this linguistic handicap was somewhat reduced

by exposure to reading and writing and subsequent acquisition of the recurring formal phraseology in RA writing. Unanimously too, all the scholars, both juniors and seniors, spoke about their difficulties in presenting research in international conferences, difficulties such as lack of confidence when interacting with listeners and engaging with them. 'When the story is told by a native, it draws your attention but you speak only what you can, no jokes, you don't attract your audience' (scholar #41). As seen in the previous chapter, this deficiency was also felt in non-native RA writing practices and hence needs pedagogical consideration for overcoming the reported difficulties.

The language barrier in writing was also apparent in speaking. The UM senior native scholars, with experience in lecturing abroad, reported that they 'try to speak very slowly' (scholar #22). Aware of the non-natives' difficulties, some UM scholars noted that the European scholars show greater and greater confidence in using the language in a relatively fluent way. Interacting with audiences was seen by the native-English scholars as the most common limitation, with variation in linguistic confidence across cultural backgrounds. Language limitation was generally considered to be more acute in Asian scholars than in European ones. For others, the situation seems to be changing favourably, probably due to the efforts of universities and the scholars' own interest in improving their speaking skills: 'Internationally, I see no inhibitions among German, Dutch, French, Swiss, Italians, but this is the transition that started in the early 1980s. Japanese had their problems and Chinese had their problems but they're in the mainstream right now' (scholar #3).

In the UZ context the most common observation on language difficulties was that this was unfair when facing an audience of native speakers. Two main reasons recurrently came up among the social sciences scholars. First, those with self-reported poor English-speaking skills expressed their discomfort by arguing that '[the natives are not aware of the tremendous effort' (scholar #73). Second, the junior scholars in particular observed that poor language may eventually lead to lack of efficiency in the transmission of disciplinary knowledge and hence 'undermine their reputation as researchers' (scholar #78). In the remaining disciplinary fields, with either wider experience in international conferences and good self-reported skills in the language, limitations were not regarded as unfair for a number of reasons. The international scope of the audience made conference participants very supportive towards language limitations (scholar #48, see also UM scholar #32). Difficulties were more deeply felt among the UZ social scientists, particularly among those with self-reported low English proficiency in speech:

> The natives don't have to prepare their paper presentations, I will never perform like them, so it's better if I prepare and rehearse my presentation. And I cannot interact like them. Then their papers are better than mine. It's not a competition but it's a merit for me. (scholar #71)

> They look at me with a sad face. I try to pronounce correctly but cannot maintain the tension, they ask you questions and I feel like 'Please, finish soon!' (scholar #74)

A primarily English-only research world renders common genre practices and disciplinary enculturation along with the adoption of the standard conventions and deviation from them. But it also shows the prevalence of normative conventions and how these are seen by the scholars in the two cultural contexts, both in their role of manufacturers of science knowledge and in their role of science gate-keepers. The effects of these discourse practices are explained in the remaining sections.

Genre Practices and Disciplinary Enculturation

Swales's (1990, p. 58) conception of research genres delimits them as a set of well-defined texts generated by disciplinary communities of like-minded peers. As he puts it, 'exemplars of a genre exhibit various patterns of similarity in terms of structure, style, content and intended audience. If all high probability expectations are realized, the exemplar will be viewed as prototypical by the parent discourse community'. The overall impression from the interview data was that the prototypical nature of scientific discourse primarily draws upon the communicative purposes it complies with. However, such prototypicality embeds variability in terms of content, rhetorical structure, style and audience, as detailed below.

The view of scientific discourse as prototypical recalled Candlin and Hyland's (1999, p. 15) claim that scientific discourse is 'both contextually constrained and context creating, emphasizing the role of social relations within discourse communities in defining what can be said and how it will be received'. While partially corroborating Prior's (1998, p. 25) views that 'sociohistoric theories point toward an image of disciplines as open networks, forged with relational activity that intermingle personal, interpersonal, institutional and sociocultural histories', the disciplinary communities involved in the interview protocols lent credence of uniform patterns for interpersonal interactions.

One of the key procedures to determine the actual process of new knowledge creation in the different academic tribes and territories was that of collective/individual interaction. In the communities of scholars researching in the biomedical, physical and social sciences, social interaction revolves around the application of the scientific method. In these disciplinary fields, initial research hypotheses (Jevons 1887), whether formulated by a single scholar or stemming from interaction among the group members, are validated and verified through collective experimentation. New knowledge is produced, shared, revised and improved by the group members in order to guarantee reliability and consistency with previous research.

Bringing to the fore the speech/writing continuum in community interaction practices, the scholars in the two cultural contexts explained that informal conversations, discussion and arguments regularly take place in the research group and help them move incipient research ahead, which very much recalls the kind of laboratory life depicted by sociologists Latour and Woolgar (1986). When a piece of investigation is mature enough, then the writing-up starts. As reported by a senior UZ physicist (scholar #41), 'we co-author papers, one of us comes up with an idea and explains it to the others, the others think and from the conversation more ideas come up and then we start the writing-up and exchange drafts until the initial idea becomes a research paper'.

As for the actual writing-up of co-authored work in experimental and problem-solving-oriented fields, drafting the scientific observation, experimentation and validation of research was generally allocated to the junior scholars. The seniors routinely took responsibility for writing up interpretations, anticipating audience reactions and framing the science in a wider context. In contrast to scholars in the humanities, where single authorship still predominates, scholars in the physical, social and biological sciences emphasized the effectiveness of 'truly collaborative' (scholar #7) work both in the gestation of ideas, commentary and discussion procedures, and in the actual writing process. In the case of transnational collaboration, with co-authors separated geographically, scholars in the two cultural contexts explained that electronic communication and digital technologies facilitate both the informal exchange of ideas and the writing task:

> Internationally, and with individual investigators, with the email it is very easy to write a paper with a colleague from the Netherlands. We just bounce it back and forth and get things organized. So the way it works, somebody gets in charge of the first draft, always somebody has to do that and once you get revised it gets bounced again so it's not a single effort. (UM scholar #3)

Allocation for writing up new knowledge claims implicitly raised issues of established hierarchies of authorship. The scholars from the biomedical fields represented in the study explained that in co-authored papers, the first author is the person who did the experiments while the second author is the corresponding author and the lab director (in the UM system) where the experiment was conducted, or the person who mentored the process. The first who signs is the corresponding author and gets the highest credit. On the other hand, alphabetical order was the normal convention in physics, mathematics, engineering, business and economics. In these fields, usually one author would take the primary responsibility for writing and the other(s) would make suggestions and comments to improve the draft. In contrast with these practices, the humanities scholars, report that they generally conduct a highly individualistic work when drafting, publishing and presenting research. Only

some of them reported to hand in their drafts to colleagues prior to journal/conference submission.

Enquiring into genre practices brought to the fore the scholars' awareness of standardized patterns in discourse and the mentor/mentee interaction during the academic and disciplinary enculturation process. In the two university settings, during the drafting of biomedical, physical and social science papers, post-doctoral students were generally given responsibilities to write the methodological procedures and draft the results. The senior scholars, acting as their mentors, write the introduction and build the discussion of the paper and only then do they put the final draft together and send it out. These procedures facilitate genre acquisition of just the most routine sections of research papers (i.e. Methods and Results) but not of the whole of it. Textual decisions concerning ways of promoting research and building persuasive arguments were generally allotted to the experienced senior scholars. While lack of exposure to the most rhetorically forceful sections of scientific genres, the Introduction and Discussion/Conclusion, may diminish the juniors' awareness of the promotional purposes of those genres, extensive reading of journal papers in one's discipline, experience gained in publishing and research group collaboration in the reviewing processes of manuscripts for preparation and resubmission may compensate for this partial lack of initial training in disciplinary discourse practices.

An interesting aspect of the scholars' views on discourse practices and procedures was the way professors initiated novices into the established discourse (genre) conventions of their disciplinary communities. The role of faculty as part of the apprenticeship process of junior scientists corroborates that 'the enculturation into the practices of disciplinary communities is "picked up" in the local milieu of the culture rather than being explicitly taught' (Berkenkotter and Huckin 1995, p. 11). Enculturating junior scholars into the social constructionist, contextual view of scientific discourse was seen as valuable for gaining writing proficiency in the discipline and for eventual academic success. This in-house procedure with graduate student co-authors worked as follows. First, the students write the draft and then the supervisor corrects, hence involving a close mentor/mentee relationship between supervisors and students, lab directors and people in the lab and senior researchers, or between clinical researchers and residents. Again oral procedures were reported to intermingle with conscientious drafting, sharing of ideas and oral discussion: '[students] give me the figures and tables, the materials and methods and give me the citations and I write the introduction and the flow of the results and the discussion and we work together with the abstract and the title. There is a lot of discussion' (scholar #4).

The mentor/mentee relationship was felt to be deeply ingrained in the two cultural contexts, which recalled Belcher's (1990) early observations on the role of professors in initiating novices in research genres within their disciplinary community. Both the UM and UZ junior scholars also explained that they handed

drafts of dissertation proposals, PhD chapters, journal articles, abstracts, book reviews and conference papers to other post-docs in the lab or in their research group for getting feedback and that they later worked with their supervisors. Both UM and UZ seniors likewise reported positive comments on their own mentor/mentee experiences during their doctoral stage, which positively encouraged them to continue the practice with their own post-docs. PhD supervision proved to be the initial stage in learning genre conventions and style:

> My advisor gave me responsibilities for making drafts and he would correct and I would learn from that, and I wrote my PhD thesis and then from that, basically following the conventions for research, you can look at a previous article, and you make sure as you go on you develop your own style format and templates. (scholar #5)

The pedagogical value of this non-formal and informal learning was particularly noticeable among the humanities scholars, who nonetheless remarked that the process of disciplinary enculturation is highly dependent on the junior's intrinsic motivation factors such as interest in learning the discourse conventions and interest in the research itself. In the remaining disciplinary fields, along with written discourse practices, participating in research group meetings and rehearsing conference presentations were the juniors' main training for constructing and disseminating science. The seniors explained that in research group meetings they sought to engage the juniors in reviewing the literature critically, presenting an outline/summary of their research in progress and revising and improving drafts and manuscripts accepted for publication but needing revision. Aware of the potential difficulties involved in the use of ELF for scientific communication, some of the UZ senior interviewees showed a marked interest in raising juniors' awareness of the importance of English for scientific exchange. Accordingly, as part of the juniors' training, the senior members imparted specialized talks, arranged informal discussion sessions in English with the juniors and trained them in presenting papers in English before attending international conferences. In the humanities, enculturation mainly revolved around elicitation of critical thinking skills (i.e. reading the literature critically) and learning discipline-specific genres such as the book review. The juniors pointed out difficulties in framing the research in a wider horizon when moving from research paper writing to PhD writing. These difficulties were related to insufficient audience awareness:

> [. . .] sometimes the reader doesn't have the same context as the writer, and then including references and making postulates in a more explicit way are necessary. Students find it difficult to contextualize the information that they have to transmit to the readers and to think about those who are going to read the text. (scholar #54)

Overall, these community procedures serve to orientate juniors and train them for successful participation within their community of interaction. Further, they clearly help novices acquire the communicative competences related to communicating for specialized purposes and with audiences. Essentially, these non-formal language practices, mainly grounded in ongoing interaction and advising processes, appear to play a vital role in improving the oral comprehension and production skills of junior scientists. These practices lend support to Lave and Wenger's (1991) claims on the senior scholars' mentoring role in helping novice writers acquire a writer's identity and apposite discourse skills – for example tackling issues of discipline-specific rhetorical conventions, grammar, semantics and discourse flow and coherence – when being mentored by senior scholars (cf. also Uzuner 2008).

From the scholars' comments, the reported 'situated learning', defined as that that the 'students acquire new skills and knowledge by engaging in the activities typically performed in a field under the guidance of more experienced practitioners' (Blakeslee 1997, p. 126), stands as an effective practice. Scholar #7 tentatively suggested the importance of raising the juniors' awareness of the promotional nature of scientific genres. As he put it, 'with graduate students, paper writing is a skill and oral presentation is a very important skill, because that's you yourself, *that's you marketing yourself,* they get practice talk and I coach them, I give them comments' (his own emphasis).

Finally, the interview protocols also revealed that efforts in improving general English-speaking skills that may complement the scholars' academic literacies. These efforts included watching TV in English, attending intensive English-speaking courses and taking private conversation classes. Remarkably, 40 per cent of the Spanish interviewees attended once a year an EAP writing/speaking course as part of the university's policy for fostering the internationalization of the institution and catering to the scholars' specific linguistic and academic literacy demands. In the UZ scholars' view, increasing practice in presenting at conferences, academic research stays abroad, collaboration with North-American and European research groups and greater confidence in the knowledge of the discipline were also important aspects contributing to overcoming limitations in their speaking ability. Other strategies, consistently used by the senior UZ scholars and, to a lesser extent by the junior ones, ranged from memorizing the introduction to presentations, writing up the whole presentation and rehearsing it, relying on power point by including more textual support than when presenting in Spanish, using short sentences and simple language. These were obviously palliative measures taken out of necessity. The peripheral, non-Anglophone scholars were conscious that not acquiring the necessary language skills will likely exclude them from the 'core/global circles'.

The Scope of the Anglophone Normative Model

In the two institutional settings the scholars explained that they were familiar with the rhetorical conventions and stylistic guidelines of research genres. However, both the UM and UZ scientists made a large number of comments on the use of normative models, particularly those related to writing/publishing research articles, the 'most valued' genre by scholars and knowledge-intensive societies alike.

The overall perception of the scholars, though more deeply noticed by those at the UZ, was that exposure to Anglophone normative models (e.g. through extensive reading) greatly facilitated the acquisition of advanced academic literacy skills and familiarity with the set of standard normative models for communicating science. In UM scholar #5's words, with exposure to models and acquaintance of normative conventions 'you develop your own style, format and templates'. An important pedagogical observation can be made concerning the non-native scholars' adherence to standard practices as resulting from extensive reading – 'it's like osmosis, through extensive reading you learn the patterns and use them' (scholar #61) –, which confirms the value of informal instruction in their disciplinary enculturation process.

In addition to relying on models, the interview protocols revealed very systematic discourse practices and procedures of interaction among the North-American-based scholars. The use of comprehensive outlines helped the scholars to progressively go more deeply into the topic and write article sections in more detail. At other times, sketching out the introduction of the paper also helped some of the UZ scholars to better 'recognize the contribution one's making and get the big picture' (scholar #33). Importantly, revising the Introduction and Discussion/Conclusion sections in successive drafts was seen as a key, useful, practice for improving the quality of the draft, which implicitly suggested that these sections involved, as reported, greater difficulty. Their non-Anglophone counterparts showed far less systematicity, for instance, in having a preplanned idea of the manuscript. The lack of a clear-cut idea in mind or lack of a paper outline became apparent in some interviewees' comments on their non-linear writing strategies. Differences across the two cultural contexts might be attributed to the strong Anglophone tradition on teaching rhetoric and composition, for years generally inexistent in educational systems of countries like Spain and Southern Europe, for instance.

In the two institutional settings the scholars further explained that they were familiar with the rhetorical conventions and stylistic guidelines of the repertoire of research genres such as journal articles, abstracts, conference presentations or grant proposals, among others. Tangential comments on research writing made it clear that, overall, writing abstracts was last in the process, mainly because of the difficulty of encapsulating in a single paragraph the

ideas presented in a paper and making them attractive to journal gate-keepers. These comments further implied the existence of strategically reader-oriented, promotional features of the abstract genre, discussed by Huckin (2001, p. 93) as all-inclusive stand-alone mini-texts, screening devices for readers, previews of the whole article and aids to indexing in electronic databases. Other genre types related to publishing practices and to scientific communication in general were the case report and the brief report in the biomedical community, described by scholar #61 as shorter than the research article, but less relevant since they involve small-scale case studies and observations are limited. Letters to the editor were also referred to as another common generic type in the biomedical academic community.

Comments on discourse practices and procedures in the actual construction of texts brought about several recurrent – and intrinsically related – themes: the constraints of discourse organizing conventions, the use of promotional language for selling research, intertextuality and citation conventions and issues of style (or ways of engaging with the audiences). Of note, these were also emerging aspects in the contrastive corpus analysis described in the previous chapter.

The UM and UZ scientists made a large number of comments on the use of normative conventions related to drafting/writing/publishing research articles, the 'most valued' genre by scholars and knowledge-intensive societies alike. Both UM and UZ scholars agreed that Methods and Results were the easiest sections of a research article because 'you just say how you did it' (scholar #44). Discussions and Introductions were regarded as the most difficult ones. The UM seniors specifically noted that Discussions involve considering open questions to which the answers are not necessarily known (UM senior scholar #2), assessing the value of the research in the light of previous literature. Writing the Discussion section was also reported to involve mastery of rhetorical strategies for conveying interestingness, motivation and promotion-related elements and, above all, foregrounding the significance of the research while being aware of the provisional nature of scientific claims. The UM scholars also referred to issues of good argumentation and audience awareness when stating limitations of research accounted for the scholars' enhanced cognitive and socio-rhetorical awareness in composing this particular genre. This enhanced awareness was also noticed in the construction of dialogic spaces explained in the previous chapter:

> The point of the discussion is not to rehash what has been told in the results, maybe one paragraph summarizing the most important aspects of the results. The results should be clear enough. The Discussion and the Conclusion should really stress why this is important. (scholar #21)

The scholars in the UZ context reported difficulties in writing up the Discussion of scientific findings. Echoing the established genre moves for Discussion sections (cf. Swales 2004, p. 234–5, 'occupying the niche → (re)establishing the

niche → establishing additional territory'), these scholars shared similar views across disciplinary domains and degrees of seniority/expertise. The difficulty involved 'convinc[ing] the reader that you are right, that your data are worth it and that your research is innovative and groundbreaking' (scholar #58) or, as scholar #78 explains, 'the Discussion section requires a tremendous effort in trying to integrate your research in the wider context, it also involves greater richness of expression when stating implications, shades of meaning' (scholar #78).

In the two institutional settings Introduction sections were described as being rhetorically forceful and hence requiring careful writing because 'it's where the paper catches the attention of the reader and convinces that the problem employed and the approach taken in the paper is appropriate for the problem being studied' (scholar #6). Filling the research gap and reviewing the literature critically and clearly so that it is understandable to readers also brought to light reader-oriented writing practices, particularly among the seniors in the two university contexts. In the humanities, the writing of essays was generally reported to be a linear process (i.e. Introduction, Body and Conclusion), it was the Introduction that scholars conceived of as most difficult since it involves 'reviewing the state of the art, taxonomizing it, assessing it critically by identifying weaknesses or gaps. At other times, synthesizing the master line of research or explaining the methodology synthetically to later apply it to a text' (scholar #51).

Introductions were also reported to involve greater effort in confronting the institutional privileges and power positions of the international community. As scholar #71 stated, 'you want to make sure about what you cite, you cite all the relevant work of other people, that you don't slight anyone'. Inevitably, the scholar's observation recalls Briggs and Bauman's (1992, p. 163) claim that 'the practices used in creating intertextual relations with other bodies of discourse' calls for the need for examining genre discourses in relation to social order and power relations within disciplinary communities. As also seen with corpus data in the previous chapter, citations were considered key rhetorical elements for persuasively selling research:

> The Introduction includes the motivation. You do it because you like it, you feel interested, it intrigues you, but then you have to sell it. Then you have to provide the motivation, justify your work and the means of doing so is by citing articles that have recently approached the topic. There has to be certain interest in the topic among the international community. (scholar #41)

Overall, many UM and UZ senior scholars perceived research article writing as 'very legible and that sells well', referring specifically to the Introduction section as 'not only informative but also persuasive' (scholar #50). The issue of 'selling' alongside 'telling' research, as Yakhontova (2002) puts it, was also regarded a normative practice, above all, in Introduction sections of journal

articles, and also in other research genres such as abstracts, grant proposals and promotion letters. Across cultural contexts, the scholars recognized that introductory sections were the most favoured textual space for selling research. This was felt more deeply by the senior scholars than the juniors in the two university contexts. The seniors' greater awareness of the socio-rhetorical constraints of the genre and, more specifically, of the rhetorical mechanism for selling research such as intertextuality, implies that successful mastery of rhetorical skills, 'acquired in a social context and through practice, is inseparable from the practical mastery of a usage of language and the practical mastery of situations in which this usage of language is socially acceptable' (Bourdieu 2001, p. 508).

As for normative style, the most recurrent comments unanimously referred to economy of words and clarity when conveying ideas. The style of scientific discourse was consensually defined in terms of 'clarity' and 'brevity' by all scholars, with emphasis on grammatically simple texts and simple vocabulary. Aware of the tenets of clarity and simplicity of expression of the Anglophone normative model, some UZ scholars, particularly the senior ones, referred to the highly phraseological profile of scientific discourse, as also attested by previous corpus data in Chapter 4. A senior, very experienced physical scientist at UZ explained that they 'use set phrases, and the style is very simple, very direct and straightforward' (scholar #44). Noticeably, despite the UZ scholars' reported awareness of succinctness of style, they often found it difficult to summarize or synthesize information not only in English but also in their own language, which might explain the digressive and elaborate argumentation of their texts, as illustrated in the previous chapter. In contrast to those in other disciplinary domains, the UM and UZ physical scientists explained that lexicogrammatical (phraseological) units were 'a database' (scholar #50) of set phrases that scholars resort to when textualizing new knowledge. As part of the ethos and epistemology of non-experimental, theoretical fields, both UM and UZ scholars in the humanities enjoyed more flexible stylistic conventions and hence advocated more flexibility of individual styles – 'at least in the humanities field, a field in which scholars are usually more concerned about the use of stylistic devices' (scholar #12). Standardization, though, underpinned their comments on flexibility and individuality of style. As further noted by scholar#12, '[i]n the globalization world you should recognize that you're speaking to a wider audience and so you have to control your syntax, your vocabulary, avoid idioms and metaphors, but it's not my style, not my personality' (cf. also Pérez-Llantada 2007).

Recurrent comments on the standard normative style referred to the degree of tentativeness vs assertiveness in making scholarly claims. Scholars in the two cultural contexts explained the need to convey claims cautiously due to the provisionality of science – hence, for example the standardized recurring use of probability grams in Discussion sections reported in Chapter 4.

Counterbalancing tentativeness, assertiveness of style, both UM and UZ scholars noted, was also necessary for promoting, giving significance to the research reported in the article. As stated by scholar #44:

> [style] has to be very effective, assertive – *and therefore, moreover* – and show that what you're saying is supported, you have to speak forcefully and convey a sense of purposefulness, you've tied the ropes and what you're saying is supported by this and this and therefore it is a result that can be disseminated.

Other recurrent comments in the two cultural contexts also focused on the importance of persuasion. Both UM and UZ scholars in the experimental sciences agreed that persuasive argumentation in Introductions and Discussion above all, presented stylistic challenges. The scholars in the Humanities and Arts were particularly concerned with the argumentative force of the Conclusion sections of their papers as they involved using language fluently and strategically for the commentary and interpretation of research outcomes – 'that's part of the story that I want to tell' (scholar #11).

On Deviations from the Anglophone Normative Style

Deviations from the Anglophone normative model were tracked by asking scholars about the kind of comments they generally receive from science gate-keepers, namely, editors/reviewers of prestigious scientific journals. Needless to say, the peer review process run by scientific journals very much determines the acceptance of a manuscript for publication, and hence the eventual dissemination of science. The scholars' comments on what the gate-keepers perceived as 'deviations' from standardized rules in scientific communication rendered perceptions on language use among the Anglophone academics on the one hand, and, on the other hand, self-perceived language difficulties – that is, language burdens in science dissemination – among their non-Anglophone counterparts.

The UM scientists mostly agreed that referees' feedback provides them mainly with feedback on content (e.g. the need to clarify ideas or comments, provide further details on the data and the methodology of the study), but not on style. Occasionally, journal referees asked these authors to revise some ideas, or expand on a particular section of the paper, always targeting clarity of research reporting. They explained that just occasionally reviewers may opine that they use 'an excessively grandiloquent expression' (scholar #1). This observation, though, should be taken not as a generalization across the native-English scholars but rather as an individual author's linguistic fingerprint or idiolect.

In their role as journal referees, the UM scholars also reported on some common authors' pitfalls such as 'knowing where the discussion has gone

off the track so much that you have to say something about it' (scholar #4), implicitly evoking previous comments on the difficulty of argumentation in research writing processes. Further, their comments as reviewers made it clear that clarity and simplicity of style are a must and reported that sometimes they criticized verbosity and lack of succinctness. These were, for instance, textual features tracked in the L2 English texts analysed in the previous chapter. In this respect, adherence to normative rules rose perceptions on English language usage and formal style conventions. One of the scholars explicitly contrasted English with other foreign languages in terms of simplicity and noted that 'the English version takes up a lot less space than their languages, so it seems to be that some of the words are shorter or you don't need so many words to express those ideas. There does seem to be some economy of space' (scholar #33). Only 1 of the 40 UM scholars stated that simplicity of the Anglophone normative model constrained the richness of language or one's own personal – ideolectal – style and, furthermore, was regarded as unacceptable according to journal gate-keepers: 'deviation from the standard language was occasionally opined by reviewers as an excessively grandiloquent expression' (scholar #1).

The UZ scientists had much to say about the review process and, in particular, about the normative language standards. A few scholars noted that referees' feedback was related to improving the literature review (e.g. including new titles), and aspects about the quality of the data, using the appropriate methodology or having appropriate research questions. They stated that reviewers were mostly concerned with the need to justify the interest of the study and highlight the strengths of the research – both aspects clearly related to rhetorical force and promotional aspects of the discourse mentioned earlier, and with making the scope of the local research significant and of interest to the international scientific community. The referees' observations might suggest some lack of understanding or, perhaps, lack of knowledge of the socio-rhetorical conventions of the research article genre in English-medium journals. It might be further argued that the reviewers' comments on 'locality features' of science evoke once again the tension between the local vs core centres and the predominance of the latter over the former in deciding what is 'significant and of interest' in the international scientific community.

From their experiences as authors, the UZ scientists reported that manuscripts were never rejected because of their poor English. Reviewing of the actual grammar was not reported to be a common practice in the interviews. Clarifying ideas and adhering to simplicity in writing were reported to be common comments. Referees recommended to seek clarity and simplicity of style as well as synthetic contents. As scholar #63 explains, 'they ask us to simplify, what we say in ten pages can be said in less than that' and 'they return the manuscript with underlined sentences that we should clarify'.

Comments on succinctness of expression were at times accompanied by reviewers' recommendation that the manuscript 'should be revised by a native

or an English proficient colleague'. Some scholars did explain that reviewers regularly complained about their poor English and that the publishers themselves provided language revision and actually improved the quality of the manuscript. This, though, was not always a very successful process in the scholars' view, since revision sometimes entailed changes of meaning in the manuscript – 'they changed the sentences but also the meaning, not what we wanted to say' (scholar #62).

The UZ scholars were sometimes critical about the quality of the reviews and felt prejudiced about language issues. Some scholars stated they had received referees' comments such as 'check your English' (scholar #71) or 'it should be revised by a native' (scholar #73). Surprisingly, these comments were received by scholars who reported they used translation and language revising services (6 out of 10 social scientists and 3 out of 10 physical scientists). As the scholars observed, 'they tell us *check your English* when the article's been translated by a native' (scholar #71) or '*you don't say it this way*, when I have hired a translator' (scholar #46). Some others explained that some reviewers made comments about the use of English but at the same time made 'mistakes in their own English' (scholar #46, also #48), or their use of the language was noticed as not being that of a native speaker – 'it's English with Latin terms' (scholar #44) or they recommend to 'check your English' even if it has been translated by a native speaker (scholar #72). These observations clearly indicate some intermingling factors in the actual reviewing process. Either there might be some kind of prejudice against non-Anglophone contributions had the reviewers been Anglophone speakers, or the translation/revision process involves mastery of the language but perhaps lack of familiarity with the standardized discourse practices or, simply, that referees are not provided with detailed, chartered criteria to judge equally, regardless of whether referees are native- or non-native English speakers, what 'acceptable' scientific English discourse and style should be.

Recalling comments received by journal gate-keepers, a few UZ scholars reported self-perceived language difficulties (see also J. Flowerdew's 1999 survey of Cantonese L1 academics in Hong Kong, with two thirds of subjects reporting to be at a disadvantage in publishing in English as compared with native speakers). Only a few stated that they write directly in English 'because translating is very complicated' (scholar #75). The majority of the UZ scholars explicitly described their writing style as dense, elaborate and non-synthetic – very much resembling the Spanish intellectual style described in the previous chapter. Some UZ scholars explicitly stated that adhering to the standardized simplicity and conciseness of style in prestigious English-medium publications was particularly difficult due to their ingrained culture-specific intellectual tradition and way of thinking: 'In [English] we use long sentences and paragraphs, sometimes too pompous, and this is totally different from the more straight-to-the-point, short sentences in English academic writing' (scholar #7).

As reported by St John (1978), the Spanish scholarly tradition was said to use an elaborate, syntactically complex language compared to the simplicity of standard normative English. This was confirmed by numerous UZ scholars' remarks that Spanish academics use very dense language, are not capable of synthesizing and tend to overuse introductory paragraphs and grams such as *with respect to* or *with regard to*.

Alongside issues of languages the impact of culture was also raised by the UZ scholars. Implicitly suggesting that Spanish language is more assertive than English, scholar #62 made a further point in terms of cross-cultural divergences. He argued that while reporting of results was merely research-grounded, objective and therefore very simple to write up, in Discussions sections 'we Spaniards tend to be more tentative and cautious', an authorial stance which was mainly attributed to 'very bitter experiences with journal referees' in this respect. Along similar lines, some UZ senior scholars, aware of the varying clines of authorial stance in scientific communication, explicitly referred to culture-related preferred grammatical constructions such as the use of impersonal forms, by noting that

> [. . .] personalizing claims is regarded as a bit egocentric and we tend to prefer more impersonal structures (*the results indicate that*). I don't know why but in our culture excessive egocentrism is not well regarded and we tend to use subjunctives and impersonal constructions. (scholar #62)

Finally, some recurrent observations among the UZ scientists addressed the issue of language burdens and linguistic inequalities. Reported burdens related to richness of expressions and lexical constraints. Finding the right word was reported as a recurrent handicap among the UZ scientists for overcoming the gate-keeping process successfully. Most of the UZ scientists explained that they 'have clear ideas but find it difficult to write them down' (scholar #78) and that this amounted to not only an additional language effort but also additional time spent in drafting and revising a manuscript. As scholar #41 stated, 'when you write in Spanish you can write nicely, not a literary piece, but not poor language, and this is what happens when using English. You don't say what you know, only what you can'. A palliative measure to address the problem of 'not using the same expression, the same discourse marker', as plainly stated by scholar #71, was to resort to language advisors for improving the richness of style and precision, even though scholars explicitly noted that they make an effort 'to make short sentences and use simple grammatical constructions' (scholar #48). This, in turn, recalls this volume's previous claims on the discoursal hybridity of the L2 English texts.

The language/literacy continuum raised as a final emerging point in the interview protocols. A considerable number of the UZ senior scientists explained that they acknowledged gained expertise in critical thinking skills

and in the use of promotional language and strategies for writing up science with authority although for educational reasons they do not handle the English language accurately, meaningfully and appropriately. Specifically, some of these scholars reported that they overcame this linguistic handicap through extensive reading and writing practices. Academic and disciplinary enculturation as well as exposure to and training in academic literacy practices may thus partially overcome insufficient language knowledge, which partially corroborates Swales's (2004, p. 56) observation that 'the most important distinction in today's research world is in consequence no longer that between NSs and NNSs of English but between experienced or "senior" researcher/scholars and less experienced or "junior" ones'.

Further differences were found among the UZ senior/junior scientists. For a small group of seniors, language still represents an additional burden even if they have had the opportunity to do post-doctoral studies in the United States or study in European English-medium universities under the Erasmus programmes or have research collaboration with Anglophone higher education institutions. Even if they are published authors, their limitations in using the language often make them rely on language revisers to ensure the linguistic quality of their papers. In contrast, the younger generations acknowledged that they have profited from national initiatives for fostering foreign languages at an educational level and predict that the national and EU initiatives in language policies may make the forthcoming generations better equipped in English language skills. A critical view, though, on Spanish higher institutions' general lack of interest in catering to scholars' specific linguistic needs for research publishing was widely agreed on by both UZ senior and junior scholars.

To provide a more comprehensive view of the scope of normative language and the deviations from these standardized conventions, the following section summarizes the UM and UZ scientists' perceptions, decisions and attitudes in their role of journal gate-keepers. While the comments that follow cut across many genres (e.g. abstracts for conference presentations, PhD proposals, grant proposals), the impact of language and culture as seen by the gate-keepers was, again, most deeply noticed in the journal article genre.

Perceptions and Attitudes as Gate-Keepers of Science Dissemination

Perceptions on gate-keeping practices finally raised similar observations on the impact of languages on scientific communication and, in particular on the role of ELF in the current academic and research context. In their capacity as journal reviewers, the UM and UZ scientists referred to the significance of the study, the novelty, originality, interest and the quality of the data as the main criteria for acceptance for publication. Consistently in the two institutional

settings, 'interestingness' was seen as a crucial aspect in determining acceptance in the peer review process. This aspect was summarized by one of the scholars' reference to the classic reviewer's comment: 'In this paper the results are new and interesting, unfortunately what is new isn't interesting and what is interesting isn't new' (scholar #4). Further, the two sets of interviewees consistently provided recommendations on the methodology, the formulation of hypotheses or commented on insufficiently supported statements as a flaw in the argumentation of the claims made. Specifically, the UM scholars rejected papers because of flawed methodological procedures, findings not supported by methodology, not acknowledging limitations, displaying insufficient argumentative force of the claims, flabby thinking or carelessness of the research data.

Together with good content – or as the scientists in the two institutional settings put it, 'good science' – language and clarity of expression were important criteria for assessing the quality of science, not only in journal publications but also in the broader repertoire of research genres, mainly the written ones mentioned above. Overall, a research paper, a PhD proposal, a research grant or a conference paper were considered to be acceptable as long as they make it explicit and clear that they involve a significant contribution or advancement in the field. Though this attitude clearly prioritizes content over form across genres, in their role of reviewers none of the two groups contributed effectively to solve shadings of interpretation and lack of clarity of ideas, except for the observations below.

For the senior UM scholars, with experience in journal refereeing, as well as for the junior ones with comparatively less experience, poor use of the language was not a rejection criterion ('we can fix the English', scholar #4) as long as the manuscripts meet certain criteria in terms of interestingness of contribution, methodology and soundness of results. Only occasionally, 'when the English is so bad that as the reader you struggle to figure out what they say' (scholar #33) are manuscripts rejected. Echoing the UZ scholars' critical comments on referees' attitudes, scholar #33 further remarked as follows:

> It's a tough thing, I mean there are some cases where you think there might be a good idea in a paper but it has been expressed so badly that it's hard to tell or maybe wrong, that it might be rewritten, it might actually work, but you wonder whether or not the author has the language abilities to actually succeed at doing it, these are tough papers to deal with. Authors would get these suggestions from the reviewers to have it read or revised by a native speaker.

The UM scientists explained that they made no substantial grammar corrections and rather provided overall feedback regarding insufficient mastery of collocations and phraseology as well as unsatisfactory register awareness.

Likewise, only a few UZ scholars as reviewers made specific suggestions for improvements in the style, most of them recommended that authors have the paper revised by a native-English speaker or colleague. Occasionally, the two sets of interviewees stated that they suggested rewording of sentences or paragraphs, and to contact 'a native English-speaking collaborator' (scholar #22). Scholar #5 explicitly referred to paucity of grammar among Asian writers in China or Korea but not in the case of Europeans (cf. also J. Flowerdew's study on Chinese academics' difficulty in writing up research). Only very occasionally, he stated, did he reject a paper because the English was not sufficiently good and recommended the authors to have the paper revised by a native-English speaker. Publishers and journal editors, and not the peer review system, were reported to be responsible for minor language changes in contributions by non-native scholars. Poorly written manuscripts and poor content, junior scholar #6 noted, do not even reach the review process.

In general, across all the disciplinary domains, being clear, persuasive and convincing were also common concerns among the two sets of scholars acting as journal gate-keepers, which implicitly suggests if not a lack, then possibly weak skills in building effective arguments when composing texts and in using promotional language. Some scholars in the physical sciences specifically noted that correct and comprehensible language (English) was one of the criteria editors and reviewers used for assessing manuscripts. Some senior physical scientists at the UZ reported that they also recommended language revision when reviewing poorly written manuscripts because it was one of the aspects included in the template for reviewers' reports. They tended to adopt cautious stances when making particular observations on language, and simply used the general statement 'it should be revised by a native' (scholar #52) when recommending language revision. Significantly, observations on Asian writers' paucity of English were accompanied by mixed feelings pointing out, on the one hand, the difficulty of writing in an additional language and, on the other, the importance of clarity in transmitting information. Scholar #50 noted that 'if you're not writing in your mother tongue you are not expected to write perfectly, but publishable material should always be comprehensible'. Like their UM counterparts, the junior UZ scholars were able to identify 'baroque language' (scholar #72) or 'lack of clarity in expression' (scholar #78, UM scholar #7), but did not dare to criticize poorly written texts. No similar comments on explicit journal criteria related to language issues were provided by the scholars in the remaining disciplinary domains.

The impact of an L2 in science dissemination elicited a number of comments on the scholars' attitudes and perceptions. As reviewers, the UM scientists generally showed sensitivity towards non-native English speakers' use of English as an additional language. 'If you see the struggle but you see some glimpse of a very good idea, that to me is invigorating, to see the struggle of the scholar trying to figure out what he means', scholar #32 noted. They all

accepted that being monolingual was a linguistic handicap and further added that they made lenient comments such as the following

> [. . .] you need to reword that but I know based on what you said that it is not what you meant. Or conversely, that you've implied this, but be very careful, that sentence can mean two different things, and make sure that you mean this by it, because that's what you have said. (scholar #4)

That said, the UM scholars also reported having come across cases of papers being ambiguous or difficult to read because of poor English.

None of the UM scholars with experience as a reviewer had ever rejected a paper on the basis of language and, in general, they explained they seem to overlook non-native difficulties. As scholar #6 put it, 'we don't worry about the English anymore because there are a lot of people in my field in Japan. I haven't seen anything that reads really bad in English and in their writing when they're submitting. But I know these guys. Somebody's fixing it for them'. Some of them even showed relatively little concern about correctness of the language since they presuppose that scholars are provided with language revising services. Scholar #5 further added that he knew cases of articles rejected on the basis of poor English: 'I suspect that in a number of cases papers have been rejected not because the science is bad but because the English describing it was bad, that you couldn't figure out what they're trying to tell you and that makes for a bad situation'.

Significantly, the UM reviewers' observations on vocabulary, syntax and pragmatic aspects of non-native English contributions appeared to match the self-reported language difficulties regarding poor vocabulary and expression in general. Further, for the UM scholars, syntactic elaboration appeared to make the non-native contributions not always satisfactory in terms of clarity of style and readability. This was seen by their non-native English counterparts as an unjust disadvantage when seeking publication. Good science 'framed within beautiful language' gets published more easily (scholar #43). Along similar lines, scholar #75 noted that English is not a rejection criterion in a good manuscript but 'may be so in borderline cases'. In addition to syntactic complexity and paucity of lexical expression, modulating claims, the expression of authorial commitment and degrees of (un)certainty, for instance in relation to research results, was another area of difficulty perceived by the native-English scholars in their role of reviewers.

From the overall perceptions of gate-keeping practices, it could be argued that the current peer review process, with increasingly multicultural/plurilingual refereeing boards may be developing culture- and language-sensitive views towards standardized English and the impact of culture and language within a multicultural publication context. Further, the best prospect for refining peer review seems to lie in providing uniform, explicit review criteria and

reviewer training rather than relying on broad categories such as accepted with minor changes/accepted with major changes/revise and resubmit/reject. After all, guaranteeing homogeneity, validity and reliability in gate-keeping practices can be a quality assurance system for the dissemination of every field of scientific research. Needless to say, gate-keeping has a long line of victims and thus needs to be fully understood in the current 'publish or perish' context. Indeed this is a field for future investigation.

It is hoped that the practices and procedures of scientists in research sites belonging to core and peripheral countries may have provided a clearer understanding of science dissemination in relation to institutional pressures and, more broadly, contemporary globalizing processes. The following chapter offers research-informed discussion on science, English and globalization in the light of both quantitative and qualitative data reported in this and the previous chapter.

Chapter 6

Triangulating Procedures, Practices and Texts in Scientific Discourse

Towards a More Complex Rhetorical Paradigm for Science Dissemination

As illustrated in the previous two chapters, the emerging picture of contemporary scientific discourse becomes one of multilayered complexity. The corpus-based analysis of the actual written products along with the data retrieved from the interview protocols point to the need to triangulate three intersecting scenarios. These scenarios are summarized in Figure 6.1.

The first scenario for the construction and transmission of science involves disciplinary procedures. In this scenario, scientists get to know the ethos of the discipline in depth and engage in problem-solving activities that bring about the new knowledge. A substantial amount of scholarly reading and simultaneous critical thinking is needed in order to identify research gaps. Research enquiries are gestated, experimented and/or contextualized against the background of the current literature to the point that they become sufficiently mature and significant to be presented as relevant findings to peer colleagues in the discipline. Through both critical reading and thinking scientists make the new knowledge sufficiently original and value-laden to be finally presented and defended in textual format – for example, a published draft, an oral presentation, a public defense, etc. This scenario displays a fair amount of heterogeneity as the different academic tribes and research territories, as those under exploration in this volume, hold distinctive community practices and procedures.

In the second scenario, that of discourse community practices, situated learning takes place. Scientists are enculturated in the specific academic discourse norms, for example, information organization conventions, argumentation and using the appropriate style for interacting with peers across the genre repertoire. Mentor/mentee interaction, particularly during the PhD period and in the beginning of a research career, proves to raise awareness of both rhetorical and stylistic features of scientific discourse. By means of this situated learning, both junior and senior scholars participate in research

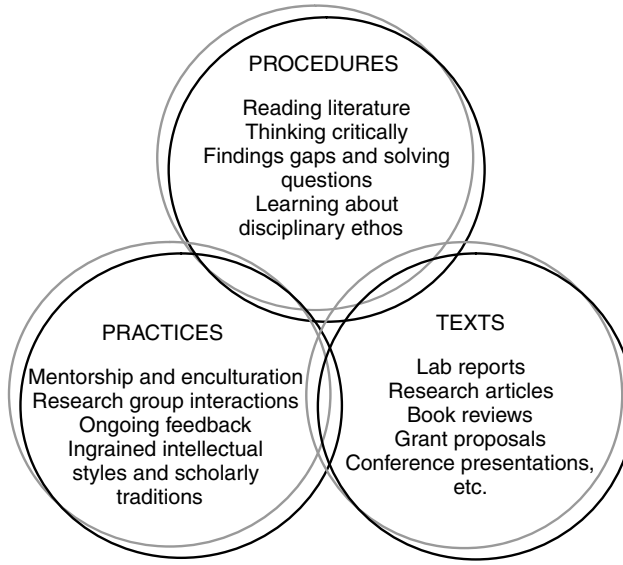

Figure 6.1 Three intersecting scenarios for the construction and dissemination of science

group interactions and conduct collaborative work within their own disciplinary community network on a regular basis. On a regular basis too, they participate in national-based and international conferences and related academic events and receive feedback from peers outside their 'small'/'local' community of interaction.

Intersecting with these two scenarios, the third scenario embodies the actual texts, understanding the latter as both processes and products. In this scenario scientific knowledge is textualized, as stated earlier, knowledge becomes text and text begets knowledge. As evidenced by the ethnographic data given in the previous chapter, this process involves brainstorming outlines, drafting lab reports, writing up full versions of manuscripts, preparing conference proposals or research grants. Prior to being considered an end-product, scientific discourse has been shown to involve a fair amount of collaboration in bouncing back and forward drafts in the case of co-authored manuscripts and an ongoing process of improving the quality of drafts in the case of single-authored ones. In this scenario, members of disciplinary communities in the different fields of scientific enquiry gradually become familiar with the socio-rhetorical functionality and communicative purposes of genres within their particular disciplinary tribe. These members learn about the social as well as the institutional gate-keeping that sets the limits of acceptability in terms of scientific rigour and credibility in the process of scientific production

and dissemination. The final end-products show considerable standardization of lexicogrammar patterns and rhetorical organization of information. But even within this relative homogeneity in the textualization of new knowledge, contrastive corpus data reveal varying intellectual styles anchored in cultural values, hence bringing to the fore a rich diversity in contemporary scientific discourse practices.

Exerting an impact on the three scenarios stand the exigencies derived from scientific knowledge production, from knowledge-intensive economies and from the synergy between universities and research and innovation activities. These exigencies are discussed below in relation to the ongoing debates about the challenges, advantages and disadvantages of an increasingly plurilingual and multicultural research world.

The Exigencies of Scientific Knowledge Production

From what has been reported previously, scientific knowledge production in the global village can be described as both uniform and fragmented, both features being clearly reflected in the very textual nature of scientific discourse. As for the former feature, uniformity, scientific knowledge production has been shown to display particular standardized rules for the sake of complying with the communicative tenets of clarity, brevity and sincerity. This uniformity has been textualized through the use of recurring lexicogrammatical patterns and in writers' adherence to the standard information organization conventions in the composition process of scientific discourse. These standardized rules are mainly targeted at guaranteeing successful communication across local, intranational and transnational disciplinary communities. As previously discussed, the degree of interestingness of new knowledge claims within the confines of disciplinary communities and the transferability of these claims for the welfare of society are prevailing concerns in the manufacture of knowledge. Not by chance did Becher and Trowler (2001, p. 104) argue that 'a fresh insight, a new discovery, a novel invention, unless made available to others in the public domain, will remain no more than a piece of private intellectual property, fated to accompany its owner to the grave'. Uniformity of expression is, and should continue to be, the ruling principle for transmitting new knowledge claims in a rigorous, objective and accurate manner. Recurring phraseological units and information organization conventions represent a solid linguistic skeleton that facilitates knowledge dissemination across scholarly communities, particularly at a moment where the very objects of research enquiry become more and more specialized. Besides, uniformity corroborates the conceptualization of discourse communities as well-established social entities sharing common disciplinary goals, specific genres and participatory mechanisms for effective information exchange.

Scientific advancements today are assisted by the latest technologies and human resources in order to further scientific knowledge; from what has been commented above it seems we are also living in an age of exploration. As reported in the interview protocols, limitations in not being able to sufficiently understand reality or make new knowledge fully transferable have called for increasing multidisciplinarity and collaboration. The Human Genome Project may come to mind to illustrate this point. Nearly a decade ago, the first human genome sequence was decoded thanks to joint efforts of the international, publicly funded Human Genome Project and the US private funding company Celera Genomics. The decoding of the human genome definitely brought about spectacular advances such as the International HapMap Project and the Encyclopedia of DNA Elements (ENCODE), bringing further scientific light into the mapping of the genome. However, in an age in which research activities are expected to involve transferability of knowledge, this project has been recently criticized for lacking a clinical application – 'researchers should work with the same intensity and focus to apply the results to health' (*Nature*, April 2010, p. 649). Transferability has now become one of the premier regulations among research agencies for granting national/international projects. Like the case of the Human Genome Project, the data from the interviews foreground the need for continuous exploration and intellectual efforts for applying disciplinary knowledge production to cater to the particular needs of society.

Assuming that issues of science are complex and difficult to apprehend, fragmentation – in the sense of 'specialization' of disciplinary knowledge (cf. Long and Fox 1995, Pérez-Llantada 2004) – calls for joint interdisciplinary research enterprises. As part of the interviewees' research procedures, collaboration was reported to be very common at both a small scale (research groups) and large scale (transnational research teams) in the fields of biomedicine and physical sciences. If one looks at research production output in these fields, this is reflected, for instance, in the growing number of co-authored papers in the past decade, as also described in Chapter 2, a sign of multi-institutional networking. Taking the case of science and technology research in Eastern Europe, Glänzel and Schubert (2004, p. 259) regard involvement in cooperation through research networks as 'a dramatic quantitative and structural change in the last decades of the 20th century [. . .] attributed to the universal tendencies of globalization'. As a case in point, ALEPH et al.'s (2006) 'Precision electroweak measurements on the Z resonance', published in *Physics Reports*, 427[5–6]: 257–454, holds the record of 2,512 authors. Economic growth, technology policy and social policy are decisive factors in the trend towards increasing scientific cooperation and co-authorship.

As in the physical sciences, there is also a marked tendency to co-authorship in engineering and social sciences such as business, marketing or economics, as well as in some humanities fields such as geography, information science

and applied linguistics. Collaboration is still rare in the research production of history, anthropology, philosophy, art or, as corroborated by the humanities scholars in the interviews, literature, cultural studies and theoretical linguistics, among other fields of enquiry.

At this point, it would also be appropriate to consider the concept of collaborativeness from the perspective of reception theory or, as Thrall (1992, p. 68) puts it, 'responsive reactions an author anticipates'. As reported and attested earlier, scientific exchange of new research via research group meetings or participation in specialized projects implicitly foregrounds the issue of cooperation in the contemporary research arena. Collaborativeness is essential in scientific knowledge production. It involves communication chains with research group members, colleagues in the prepublication process and with editors and reviewers of the texts in the publication process. These social agents all take dialogic stances and hence contribute to some extent to the final textual product. In a sense, these agents may be taken to modulate and even limit the authors' initial ideas in order to make the new knowledge claims acceptable by the community of specialists.

Within this context of collaborative research, English becomes the common language for the purposes of disseminating knowledge and cooperating transnationally. The interview protocols revealed that international cooperation was more highly valued by the scholars in the non-Anglophone (Spanish) context, who regarded it as a way of getting rid of parochialism and accessing the world outside. In addition, in their role of science gate-keepers both the UM and UZ scholars noted the need to report 'science' which is significant and interesting to the global – and not just the local – context. From the above, one may conclude that in so much as the new knowledge textualized in a generic form of scientific discourse raises interest and accounts for novelty within the mainstream disciplinary knowledge, the chances for 'global' acceptance increase.

Reconciling uniformity and fragmentation in scientific dissemination practices, scientific English merges objectivity in the transmission of disciplinary knowledge with authors' particular engagement with readers when presenting new knowledge claims. As explained previously, the scientific community operates on the basis of mutual cooperation and intercultural understanding. It primarily relies on ELF for the transmission of information. This results in a fairly standardized use of the language, which evoke the Gricean maxims of quantity, quality, relation and manner as basic tenets in intercultural pragmatics (Grice 1975, cf. also Davies 2007). While the words of science and the scientific method are universal, the agreed view of contemporary scientific discourse as provisional entails a highly interpersonal and dialogic type of communication. As a result, provisionality of the new knowledge claims together with scientists' willingness to foreground the interestingness and value of the new knowledge claims also explain the reported strategic use of

linguistic resources conveying promotionalism on the one hand, and tentativeness in interpreting their claims and seeking acceptability by the peer audience on the other hand. As a result, scientific discourse is eclectic insofar as it is referential and provisional, but also promotional so as to fulfil its two main communicative purposes: informing the audience of new knowledge and foregrounding research highlights, but also alerting them of the provisionality and limitations of the new knowledge.

As evidenced in the previous chapters, the key role of citation and intertextuality in scientific discourse also instantiates scientists' strategic ways for framing new knowledge, expressing the motivation of the research convincingly while moving the research field ahead. The textualization of new knowledge bears multiple traces of previous texts and scholarly voices. In addition to explicit intertextual references, latent influences of others' voices in published scientific discourses also recall discontinuity and fragmentation in scientific discourse. Both intertextuality, a concept imported from post-structuralist literary theory to refer to references to other's texts, and citations, or explicit instances of manifest intertextuality, as explained earlier, indicate a well-established standardized convention in scientific discourse and implicitly reflect the fragmentation of an apparently self-contained text. Borrowing Bourdieu's claim that power operates outside the texts, Pennycook (2007, p. 61) defines intertextuality and citation as textual responses to the contextual constraints of texts, as quoted below. These observations certainly apply to scientific discourse:

> [. . .] what ties performance together is not a competence that lies within each individual but a wide array of social, cultural and discursive forces. [. . .] the meaning of a text is viewed in terms of its pre-textual dialogic history of performance, intertextual relations between texts, contextual embeddedness in use, and sub- and posttextual frames of meaning and interpretation.

Contemporary scientific discourse brings to the fore the use of specialized bibliographies and tools that assist and support the work produced by professional academics and researchers across the different disciplinary fields. In this respect, Abbot (2008) notes how widely scientific enquiry relies on consultation of library and archive bibliographies and consultation of electronic resources such as databases, citation indexed journals and reference lists with the latest publications.

Extensive reading practices in the process of gestating new knowledge, as also reported in previous chapters, further indicate that science dissemination in the contemporary world is increasingly English-medium. The fact that in the geopolitical order English is the leading language for scientific communication and knowledge exchange worldwide has been regarded by some as a form of linguistic imperialism (Canaragajah 1996, 1999, 2002, Gunnarsson 2000,

Ammon 2006) since the use of standard normative conventions in English for science dissemination has been described in this volume and elsewhere as a linguistic burden by non-Anglophone scientists (cf., e.g. J. Flowerdew 2008). However, a simple look at the latest issues of prestigious journals shows that the majority of the contributions come from the bulk of non-native English-speaking scholars conducting research outside the core centres, hence making their intellectual contributions 'visible' in the international landscape.

Access to libraries and other electronic resources guarantees more opportunities to conduct and eventually produce successful, interesting and novel research. In contrast, insufficient facilities or even lack of access may diminish the quality of the research and the eventual publication of new knowledge. This, unfortunately, may not be the case of off-networked scholars, with no possibilities to access the web and resort to research resources. Their unfavourable situation has been harshly criticized by some EAP scholarly fora (e.g. Publishing and Presenting Research International in English as an Additional Language, PPRISEAL manifesto) as it affects those scholars who conduct their research in developing countries. A final note on the exigencies of scientific knowledge production should therefore be made in relation to access to resources in the process of 'manufacturing' knowledge. Bearing in mind today's delimitation of governing geopolitical spaces and the availability of resources for conducting scientific research in these spaces, one will probably keep on observing marked differences in the quantity and quality of scientific knowledge production of core, peripheral and non-peripheral research sites. These issues are further discussed below in relation to the geopolitics of contemporary research production.

The Exigencies of the Globalizing Processes

A further important factor impacting scientific knowledge dissemination through discourse practices stems from the intricate relationship between scientific production and the exigencies of the globalizing processes ruling knowledge-intensive economies. As discussed in Chapters 2 and 5, one of these exigencies is the value attached not only to scientific outcomes but also to research output itself. Number of articles published has become the key indicator used by the current sociopolitical and economically dominant countries for measuring the advancement of science and technology-related research per country. Therefore, standing as commodifying items, research output production does not only contribute to knowledge dissemination across countries but also strengthens the power of global and local economies.

The number of citations of published work across countries worldwide is also another 'value' indicator to compare the strength and authority of knowledge-intensive economies concerning the advancement of scientific and

technological development worldwide. In this respect, it is worth recalling here the various rhetorical goals that citation and intertextuality perform in scientific discourse, as illustrated in Chapter 4 with the three SERAC subcorpora. In so far as disciplinary knowledge is manifested and measured in terms of textual output, it could be argued that citation and intertextuality practices contribute to making scientific discourse a commodity not merely exchanged between the actual producers and consumers of knowledge, namely the scientists, but also a value asset among competitive economies/countries worldwide. The presence of macro-socio-economic forces and the imperative to publish research in high impact factor journals appears to be fostering these shifting citation trends in scientific discourse (cf. e.g. Hewings et al.'s 2010, on non-native English scholars' practices of citation as a self-promotional strategy in English-medium publications).

In Chapter 2, reasons of competition and sociopolitical and economic supremacy and, as a result, growing emphasis on bibliometric data appear to come at the forefront of scientific knowledge dissemination and knowledge transfer among research communities. This conception of scientific discourse would hence align with Lyotard's (1984, p. 4) pessimistic view that 'knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorized in a new production: in both cases, the goal is exchange'. In the contemporary research arena, scientific output is a tool for mutual, collaborative exchange within disciplinary communities as well as a profitable investment in social welfare and development. It has become a lucrative political and economic tool that can make strong economies worldwide even more competitive, to the detriment of less-developed or underdeveloped countries. This competitive landscape might just be a sign of competition reflecting the need for promotionalism among the scholars themselves. Corpus data indeed showed promotional features in the scientific texts and the interview protocols raised issues on the 'publish in English or perish' world for promotion purposes. However, it is worth remembering here that this was not exactly the overall stance of the two sets of scholars interviewed. In the two institutional settings, the scholars widely claimed other more altruistic motives such as dissemination of new knowledge worldwide and personal satisfaction, relegating reasons of promotion and prestige to secondary position. One may therefore conclude that it is not at a disciplinary community level but rather at an institutional level and, of course, at a wider socio-economic level that scientific knowledge production operates as a commodity and that a highly competitive environment is more deeply felt.

But, as one of the UM scientists also argued, measurements of scientific productivity on the basis of scientific discourse output production and citations are not always fully satisfactory according to recent scholarly literature. Pauly and Stergiou (2008) refer to this phenomenon as the 'citation-based Index of New Knowledge (IKN)'. Others report that assessment of scholarly production

by means of bibliometric data based on the number of publications in impact-factor journals is not always reliable and may even deteriorate the quality of science. Others have gone even further and argued that bibliometric measurements are problematic for assessing the quality of published papers. Starbuck (2005, p. 196) provides very satisfactory simulations and algebraic analysis to support the idea that 'editorial selection involves considerable randomness' and proves that:

> Highly prestigious journals publish quite a few low-value articles, low-prestige journals publish some excellent articles and excellent manuscripts may receive successive rejections from several journals. Evaluating articles based primarily on which journals published them is more likely than not to yield incorrect assessments of articles' values.

Corroborating the growing use of self-citation in scientific prose for self-promotional purposes or for promoting friendly colleagues, Krell (2010) brings to the fore several biases. These measurements may be biased by the language an author uses to conduct the literature review (e.g. his/her mother tongue vs English as a lingua franca) or by the author's availability of bibliographical resources. Also, citation practices may involve either the inclusion of papers easy to criticize and/or the inclusion of most-cited papers, the latter presumably thought of by the author as being of greatest interest for the expert audience. As far as editorial journal mediators are concerned, Krell (2010, p. 61) remarks that 'it would be unethical for editors to insist on an increased number of journal self-citations, in decreasing citations of competing journals, or indeed consider journal self-citations in their decisions as to whether or not to accept a paper' since this would prioritize marketing over scholarship.

It is true that bibliometric measurements of scientific productivity and quality are advantageous if they guarantee, for instance, thematic suitability of a manuscript according to the particular scope and readership of interest of a journal. They also guarantee that a manuscript is revised in the refereeing process by both referees and editors and that, if accepted, the manuscript is drafted and improved in terms of contents (quality of science), rigour in the use and application of the methodology and clarity of ideas and expression. These aspects may be seen to counteract the alleged subjectivity of citation-based measurements. It would then be advisable that scientific publications provide explicit guidelines on publication ethics, on pedagogical grounds, that novice scholars are explicitly trained in ethical principles, both as authors and reviewers. The issue itself clearly suggests avenues for future research on the adequacy of methods for measuring the quality of scientific production.

A final further consideration in this respect is Toal's (2000, p. 166) observation that the 'postmodern geopolitical condition' of a state 'is the process whereby national institutions, policies and practices are forced to adjust to

the evolving dynamics and demands of the capitalist world economy'. The shift from the modern to the postmodern geopolitical condition may likewise be reflected in the growingly complex nature of scientific discourse. Contemporary scientific discourse is primarily devised as a textual means for knowledge dissemination but concurrently plays a role in the marketization of knowledge production worldwide. From this perspective, it is then relatively easy to confirm the view of the nature of scientific production as a commodity related to the needs, interests and demands of the dominant sociopolitical and economic orders concerning international academic and research cooperation. Again, one might say, global prospects are served by local endeavours.

The interview protocols rendered further evidence of the effect of the postmodern geopolitical condition and, as also stated in the previous section, of the existence of core/periphery geopolitical spaces for knowledge construction. As argued by Canagarajah (2002, p. 235) these core constructed spaces hinder the successful participation of those scholars in the periphery 'whose thinking doesn't involve knowledge production at a wider level because of their alienation from mainstream discourses and publishing networks'. Coincidentally, language has been shown to play a key role in these spaces. As evidenced by the corpus-based analysis of promotional features in scientific discourse, data from the interview protocols brought to the fore the importance of 'a knowledge of what constitutes "interestingness" to an insider audience, which in turn depends on timeliness, or kairos' (Berkenkotter and Huckin 1995, p. 116, as argued with the case of journal abstracts and conference abstracts). One might argue that the predominance of scientific journals in Anglophone-based countries stands as one form of marginalizing peripheral knowledge insofar as the ruling agents of these journals establish what is 'interesting' and 'novel' for judging whether or not new scientific knowledge is acceptable for publication and hence eventual dissemination. Within the increasing multiculturalism and plurilingualism brought about by the globalizing processes, winds of change towards more lenient coexistence of core/non-core scientific communities may be timidly perceived. Editorial and advisory boards now tend to include reviewers from different nationalities, a trend which was also commented in the interview protocols of the previous chapter. In 2004, the *Singapore Medical Journal* explicitly raised concern on the threat of potential geopolitical intrusion of editorial decisions, advocating ethical behaviour in publishing processes. At present, this policy statement is endorsed by the World Association of Medical Editors (2004, p. 248):

> Decisions to edit and publish manuscripts submitted to biomedical journals should be based on characteristics of the manuscripts themselves and how they relate to the journal's purposes and readers. Among these characteristics are importance of the topic, originality, scientific strength, clarity and completeness of written expression, and potential interest to readers. [. . .]

> Editorial decisions should not be affected by the origins of the manuscript, including the nationality, ethnicity, political beliefs, race or religion of the authors. Decisions to edit and publish should not be determined by the policies of governments or other agencies outside of the journal itself.

Recalling the rhetorical effects of citation and intertextuality, further issues on power outside texts can be raised in relation to knowledge-intensive economies and globalization processes. As reported by the UM and, in particular, by UZ scientists, faculty evaluation on the basis of number of publications in impact-factor journals is nowadays a major concern. While this kind of evaluation guarantees the promotion and accreditation of scholars in both the Anglophone and the non-Anglophone contexts, as established by current government regulations, it is worth remembering two main issues of concern among the latter set of scholars. The first one is the subjectivity that impact factor measurement may involve, as argued earlier. The second, perhaps more deeply felt as a major disadvantage by the non-native English-speaking scholars, is that they have to publish in an additional language. The reported efforts made by non-native English scholars elsewhere in disseminating scientific knowledge in English were accompanied by frequent comments on the excellent quality of the publications written in the local language and published in national-based journals and on the way these publications are systematically disregarded for merit and promotion purposes.

While EAP scholarly research on non-Anglophone scholars' attitudes advocates a more sensitive stance on the part of journal editors and reviewers towards their language burdens, it is true that those scholars have language difficulties because they are actually participating in the mainstream knowledge production processes within their particular discourse communities. In this sense, the concept of 'periphery' would not exactly apply to those scholars having strictly discursive, language-related problems. Instead, it would be more accurate to include under the umbrella term 'peripheral scholars' those scholars trying to overcome non-discursive problems, that is to say, those who are actually deprived of access to publishing/scholarly circles and technological facilities and acceptable research infrastructures (Salager-Meyer 2008). This truly peripheral condition points towards unjust macro-socio-economic imbalances coming from the capitalist ideology and its globalizing effects. Ferguson (2007, p. 21) observes that 'the production of high quality scientific research is quite evidently an expensive business' among the core consumers of disciplinary knowledge.

The current economic crisis is deeply felt when one looks at university policies implementing cutbacks in journal subscriptions, access to databases, individual publication downloads and library loans. Initially devised as a means of rationalizing current resources without jeopardizing adequate performance of research activities, it might be sensible to advocate that these policies will indeed diminish the availability of research tools and infrastructures and act

as exclusion factors for plurilingual scholars who want to participate actively in the 'core disciplinary communities' and contribute to 'the global intellectual voice' (Uzuner 2008, p. 250).

An even more difficult position is that of those plurilingual scholars that belong neither to core nor to peripheral geopolitical centres. Geographically-based divides between core and periphery and, above all, non-periphery, can become more discriminatory due to a paucity or lack of resources or simply lack of communication and cooperation, as contended by Aydinli and Mathews (2000) taking the case of international relations scholars. The short-term palliative measures proposed by Salager-Meyer (2008) such as open access journal initiatives may be a feasible means of partially overcoming non-discursive problems. As this author further suggests, other short-term measures such as reducing the cost of scientific publications to facilitate access might also counteract the wealthy, well-established publishing industry – another 'facet' of core knowledge-intensive economies.

The Rhetoric of Science and Cultural Collisions: Harmony in Diversity?

In view of the exigencies of scientific knowledge and of the exigencies of the knowledge-based model of the global village, one may easily assume that research cooperation within and across scientific communities of practice at a transnational scale is taking advantage of ELF for communication. The status of English as a dominant instrument for communication can thus be understood in the following two respects. First, as also reported in Chapter 2 and in the ethnographic analysis of Chapter 5, competition between national universities both within the national context and in the international contexts is established by measuring through citation-based indicators the number of research articles that scientists from a given institution produce. The quantity and quality of scientific knowledge production, highly valued for promotion and merit purposes, the scientists also noted in the interview protocols, bring to the fore a dramatic shift towards English to the detriment of local languages. For example, a research article published in an impact-factor English-medium journal and a proposal presented in an international conference are more valued than those in a national-based context for the various reasons noted by the scholars interviewed. Internationally, the research output reaches a wider readership of specialists, it goes through peer-review and selection processes and it is expected to be of interest and novel for the large scientific community. The linguistic effects of these geopolitical decisions are the following.

As a lingua franca, English is being adopted by scholars worldwide who wish to remain inside and not outside the mainstream of research and academic activities. As attested in the interview protocols, in its written mode English has

become the dominant lingua franca and will continue to be so particularly in the context of research article writing but also in other academic written genres like conference abstracts, international grant proposals, research project applications, PhD proposals and PhD dissertations and formal/informal written communication using digital technologies. International cooperation and transnational scientific communication are also spreading the use of ELF to the spoken domain. Science dissemination takes place in situational contexts as varied as participation in international conferences and seminars hosting both native and non-native English participants from around the world, attendance to international research group meetings, as well as through the telephone and other types of synchronous and asynchronous online communication. In the educational context the growing internationalization process of universities, with increasing mobility of staff and students and international collaboration at an institutional level, is fostering the advancement of English. The repertoire of genres, both written and spoken, recurred in the interview protocols.

The contrastive analysis of texts described in Chapter 4 lends ample credence that scientific discourse involves a fair amount of standardization, to which both the Anglophone and the non-Anglophone scientists adhere whenever they communicate science. Several lexicogrammar patterns, both in written but also in the spoken mode, recur consistently, even if a fair amount of variation can be seen across sub-disciplinary fields, variation which is subject to the particular nature (ethos) of science they deal with. Overall, the standardization norms in scientific discourse lead to the homogenization of discourse, to the point of being this linguistic adaptation systematically criticized as a form of linguistic imperialism (e.g. Canagarajah 1996, 1999, 2002, Ammon 2006). However, in the light of the ethnographic account of Chapter 5, it would be fair to say that standardization appears to be acting as a mere linguistic phenomenon seeking to facilitate/maximize the dissemination of scientific knowledge among the actual producers and receivers of texts – hence keeping possible cultural collisions to a minimum.

As stated earlier in this volume, scholarly research in the Contrastive Rhetoric field points out that the Anglophone normative conventions for formal academic discourse allow some space for culture-specific linguistic, discoursal and pragmatic traits (e.g. Mauranen 1993a, b, Clyne 1996, Moreno 1997, Vassileva 2000, Breivega et al. 2002, Martín 2002, Yakhontova 2002, 2006, Dahl 2004, Facchinetti et al. 2004, Lorés 2004, Fløttum 2005, Vold 2006, Burgess and Martín-Martín 2008, Connor et al. 2008, Duszak and Lewkowicz 2008, Giannoni 2008, among others). As illustrated in Chapter 3, the hybridization of the texts written in English by the non-Anglophone (Spanish) scholars gives credence that the linguistic resources used by these scholars are more constrained because of their non-native status – not by chance did the UZ scholars recurrently noted, for instance, their paucity of expression when

writing up/presenting research in English. In addition, other culture-specific traits at a discourse level such as variations in the average sentence length, syntactic complexity, convergences, deviations and variations of text-oriented and participant-oriented linguistic resources to construct dialogic spaces for writer/reader interaction for instance, corroborate the coexistence of the predominant Anglophone norms with the alternative preferred choices of other intellectual styles and rhetorical traditions.

Drawing on the geopolitics of language, Ammon (2000, p. 34) coins the term 'globalish' to refer to these new language norms for international academic communication. As argued earlier in this volume, it would be rather more accurate to refer to academic English*es* (Mauranen et al. 2010b) so as to release the language phenomenon of 'Englishization' from its presumed imperialistic undertones. After all, published scientific discourses consistently display hybrid traits among the non-native English plurilingual community of scholars. It is thus not accurate to say that plurilingual scholars are losing their cultural traits 'at the cost of molding [their thoughts] in a conventional form' (Coulmas 2007, p. 6).

In addressing the impact of culture and language on the rhetoric of contemporary science one might broadly argue that cultural collisions within global competitiveness lead to harmony in diversity. The established standard norms for scientific communication have been historically prevailing in the academic milieu because of the political and economic hegemony of the ruling Anglophone countries. These established canons have proved effective for generating, constructing and disseminating new knowledge for effective communication within the scientific community and across sub-disciplinary communities. In this view, standardization of cross-cultural scientific communication brings about harmony in diversity.

In the age of globalization, contemporary scientific discourse entails 'increased interconnectedness and linguistic diversity' (Dewey 2007, p. 337). Linguistic diversity is the result of increasing participation of plurilingual scientists worldwide in English-medium journals, academic conferences, international higher education programmes, and staff-mobility programmes. Rather than 'clash of cultures' the phenomenon of Englishization brings with it the rich diversity of resources brought in by its plurilingual participants. The international stage can be reached by both Anglophones and non-Anglophones alike. Mauranen et al. (2010a, p. 647) explain that

> [. . .] there are signs that alternative ELF versions of standard written English may be emerging; for instance, *The Nordic Journal of English Linguistics* has a stated policy of accepting papers written in English without making them go through a process of linguistic cleansing. And here it is worth remembering that so-called local or regional journals [. . .] are not really local or regional any more once they make their articles globally available on the web in pdf formats.

A similar picture can be seen in the spoken domain, with increased distancing from the normative conventions among ELF users in academic and research settings on the one hand and with a greater awareness of the blurring boundaries of the native/non-native English divide in a global multicultural environment. As Mauranen (2003, p. 517) concludes, 'holding up an NS model as the target for international users of English is counterproductive, because it sets up a standard that, by definition, is unachievable'.

In the global village it is not difficult to acknowledge the pragmatic utility of English for scientific communication, as also reflected in the interview protocols of the previous chapter. The reported hybrid or 'glocal' discourses of the non-Anglophone scholars participating in the scientific arena lend evidence of a rich diversity of cultural traits within the normative scientific English boundaries. As previously discussed in this volume, these traits can be broadly defined as displaying various clines of linguistic appropriation – in other words, the above-mentioned 'go native' trend – along with linguistic accommodation of such appropriation on the basis of culture-specific intellectual styles and rhetorical traditions. The functionality of these glocal discourses is to act as 'languages for communication' as opposed to 'languages for [cultural/social] identification' (House 2003, p. 556), as also explained in Chapter 1. ELF across scientific discourse practices and genres therefore acts as a language for communication. If we apply the sociolinguistic concept of 'community of practice', small sub-disciplinary communities of practice across cultural contexts do not seem to vary to a great extent regarding the kind of discourse practices and procedures that they use for constructing and disseminating new scientific knowledge. The kind of problems in scientific communication that Barras (1978, p. 43) perceived already some decades ago may encompass the language for communication variables across cultural contexts and show great concern for a potential clash of different intellectual styles and conceptions of scientific rhetoric in multicultural contexts:

> Two processes are involved in written communication. The first, in your mind, is the selection of words to express your thoughts. The second, in the mind of the reader, is the conversion of the written words into thoughts. The essential difficulty is in trying to ensure that the thoughts created in the mind of the reader are the same thoughts that were in your mind.

If regarded as a means for the internationalization of knowledge production and knowledge transfer, scientific discourse in the globalizing context strengthens research collaboration across institutions, institutional partnerships and hence generates fruitful intercultural communication flows. While it is true that the non-native English-speaking scholars seek to adopt, as reported in the literature, the dominant discourse in order to gain visibility and get their research published in English-medium journals, the emerging

scientific English*es* corroborate the existence of rich intranational communication flows. This side of the coin suggests that scientific discourse genres perform key functional goals. The other side of the coin, though, reflects an imbalance between scientists in Anglophone and non-Anglophone-based contexts. And here is where diversity does not clearly entail harmony. For the native-English-speaking scientists, the established standardized models represent more opportunities than challenges. For their non-native English counterparts the established models represent both opportunities and challenges as far as their reported communication practices and experiences can tell us. The section below provides some controversial views on what language mediators say regarding language communication, language appropriation and language adaptation in contemporary science dissemination.

Science Gate-keeping and the Rhetoric of Contemporary Science

Compared to other fields of EAP scholarly research, there is actually not much empirical research on the role of language gate-keeping in contemporary science dissemination. Studies on peer review processes, such as those referred to below, have shed further light on a number of challenges – both content, language and culture-related issues – that the non-native English-speaking scientists face in the processes of construction and dissemination of science.

As for content issues, journal reviewers' comments to authors generally give priority to aspects such as the originality of the research, the good quality of science and the use of apposite methodology for guaranteeing evidence of the claims made. Mungra and Webber's (2010) study likewise confirms that gate-keepers' content comments included questions related to clarification of scientific data, errors in sampling, missing technical details, incorrect use of citations and lack of correlation of data. Along similar lines, Belcher argues that poor quality of science may be caused, for instance, by inappropriate methodology, methodological flaws or lack of contextualization. Some minor aspects that also lie outside issues of cross-cultural and cross-linguistic variability are gate-keepers' comments on the appropriate use of tables and figures, adequacy of the bibliographical references and formal aspects of layout. Clarity of ideas and sufficient argumentative force of the claims by means of factual evidence are other key requirements to accept a paper for publication.

Another criterion is the extent to which results (i.e. new knowledge) transcend the local boundaries and can be applied transnationally. For example, J. Flowerdew's (2001) analysis of 150 editors of 12 leading international journals in applied linguistics also shows that content-based features such as parochialism reported to cause 'failure to show the relevance of the study to the international community'. These editors' comments referred to two positive

criteria that guarantee acceptance for publication: originality of the research set against the international context and potential to impact on the *status quo* of science in the 'dominant centre'. Indeed, these criteria do not directly relate to linguistic challenges that non-Anglophone, L2 English scholars encounter but rather to what the dominant centres find interesting for the advancement of disciplinary knowledge. Failing to claim significance of the study, or to foreground the novelty, originality and interest – or as Berkenkotter and Huckin call it (1995, p. 116) '"interestingness" to an insider audience, which in turn depends on timeliness, or kairos' – may lead to rejection from publication.

Overall, EAP/ESP research on gate-keeping practices contends that it is the good quality of science, the persistence of non-native authors in the editorial process and leniency on the part of editors that make a non-native English texts eventually acceptable for publication in international journals. Belcher (2007, p. 11) succinctly describes it as 'a story of reviewer patience and author persistence'. Burrough-Boenish's (2003, p. 234) analysis of reviews from a biomedical journal for instance claims that there are 'no significant differences between the NS and NNS manuscripts in rejection rates and in scientific quality (the latter as assessed by the journal's standard rating procedure)'.

Authors like Gosden (2001), Mišak et al. (2005) and Hewings (2006) further argue that along with content-related aspects such as design and methodology weaknesses or the use of inappropriate or insufficient literature review, language use problems may lead to rejection of a manuscript. For instance, Gosden (2001, p. 9) quantified types of comments in 40 peer reviews on scientific papers, which were distributed as follows: lack of clarity and/or need for further explanation (33.8%), technical errors or inconsistencies (26.9%) and need for weakening claims (19.8%). Unacceptable papers were further criticized for lacking originality (12.5%) or format-related shortcomings (7.0%). Gosden (2003, p. 98) disputes the presumed fairness of the review process towards non-Anglophone authors' contributions as follows:

> Although prospective authors are commonly advised to read carefully the target journal's 'Instructions to Authors', there is rarely specific guidance for NNSE authors on language and style. In a survey of 500 journals, Kirkman (2001) noted the general vagueness of advice, such as that the English should be 'good', 'idiomatic', 'standard', 'uniform', 'proper', or 'the style should be lively, concise, readable', all of which is of little practical value. On the other hand, comments that referees may make on problems with English in submitted manuscripts are naturally of interest to NNSE authors, since they are assumed to be more directly helpful in polishing manuscripts as part of the revision process.

Gosden's observation seems to be upheld by the UM scholar referees, who reported that they recommend that 'English should be revised by a native

English-speaking person' when they were asked to assess poorly written manuscripts. Coincidentally, the very same kind of remark was reported by referees with the UZ scholars' manuscripts.

From the several aspects that have been criticized by journal editors and referees as weaknesses in non-Anglophone manuscripts, poor grammar and syntax have been shown to be problematic among plurilingual scholars (Benfield and Howard 2001) and particularly among those who have writing systems different from the occidental system (e.g. J. Flowerdew 2001, 2002 with the case of Chinese scholars). Taking the case of manuscripts written by Finnish academics, Ventola and Mauranen (1991) explain how editorial work actually contributes to the language improvement of scientific discourse. These authors note that editing and changes in revision are not simply concerned with grammar but also with information organization flow, poor use of discourse cohesion markers and textual metadiscourse signposts. To put it shortly, reviewers' observations mainly targeted at improving the readability and accessibility of the propositional contents reported in a scientific discourse. Similar conclusions are drawn by Lillis and Curry (2006) in a longitudinal text-oriented ethnographic study of psychology scholars in Hungary, Slovakia, Spain and Portugal. Lillis and Curry observe that the actual process of gestating a scientific discourse undergoes several modifications from a number of language mediators and that these modifications do not only affect content-based, format and grammar aspects but also discourse and rhetorical polishing of the texts.

Referees' comments on lack of clarity attributed to verbosity, repetitions of ideas, digressions and complex argumentative discourse flows have been further reported to be intrinsically related to cultural identities and intellectual writing styles (e.g. Mauranen 1993a, b with Finnish scholars, Sionis 1995 with French scholars, Clyne 1996 with German scholars, Burrough-Boenisch 2002, 2003 with Dutch scholars, Giannoni 2008 with Italian scholars, Bennett 2007 with Portuguese scholars, Duszak 2005, and Duszak and Lewkowicz 2008 with Polish scholars, and Moreno 1997, Burgess and Martín-Martín 2008 and Pérez-Llantada et al. 2011 with Spanish scholars). Taking the case of Spanish academics in a single-sited university context, Burgess et al. (2005, p. 288) note that 'the need to make the specific aims of the research clearer in the introduction and abstract' and 'the need to clearly articulate the contribution to the field' represent the two main weaknesses according to referees' reports. Coincidentally, these aspects were also brought to the fore by corpus data. In the interview protocols both by the UM scholars' experience as journal referees and the UZ scholars' awareness in trying to get rid of their culturally engrained predilection for syntactic elaboration coincided in the digressive, over-elaborate argumentative flows of non-native English scholarly writing.

More recently, Mungra and Webber (2010) report on both content and language problems in an analysis of a total of 366 referees' comments from 17 medical manuscripts written by Italian scholars and rejected for publication.

These authors explain that referees provide both content and language comments, and each type accounts for almost a similar percentage (56% vs 44% respectively), which confirms that the good quality of science is an essential part in a scientific discourse. Content comments included questions related to clarification of scientific data, errors in sampling, missing technical details, incorrect use of citations and lack of correlation of data with the claims made. The remaining, not insignificant 44 per cent of the comments, that is, language-based comments, were related to problems with repetition of ideas, lack of clarity, paucity of expression, inappropriate syntactic constructions, discourse organizational flow and authorial stance. Coincidentally, these aspects were also brought to the fore by corpus data. In the interview protocols both by the UM scholars' experience as journal reviewers and the UZ scholars' awareness in trying to get rid of their culturally engrained predilection for syntactic elaboration coincided in the digressive, over-elaborate argumentative flows of non-native English scholarly writing.

The literature has also addressed culture-specific traits in determining plurilingual scientific discourse, particularly with regard to participant-oriented metadiscourse features and the construction of interpersonality in discourse. Kourilovà's (1998, cf. also 1996) analysis of 671 referees' critical comments on manuscripts written by Slovak academics showed that language features such as style, grammar, lack of clarity, inappropriate use of modality, lack of cohesion, terminology and hyphenation accounted for 8.79 per cent of the total number of comments. While she notes that the scholars' problems with lack of clarity and insufficient explanation may be due to the fact that expository prose is characterized by 'insufficient justifying support, with main ideas inadequately qualified and elaborated' (Kourilovà 1998, p. 112), she observed that when writing in English, these scholars are

> [. . .] less aware of subtle degrees of truth commitment and of potentially face threatening acts than their English counterparts. This is largely due to the nonnative speaker's failure to know the broad repertoire of devices of the English modality system and to understand their pragmatic value and force.

Ways of constructing dialogic spaces for writer/reader interaction and reflecting authorial visibility in the texts support Gosden's (2003, p. 99) observation that 'much critical feedback from referees may be oriented towards revisions whose underlying rationale is more interpersonal than ideational/technical in nature'. As argued earlier, CR literature amply reports varying uses of pragmatic politeness strategies, different perceptions of the English modality system, varying clines of authorial stance and differing strategies for modelling persuasion (e.g. Breivega 2002 with French and Norwegian scholars, Duszak and Lewkowicz 2008 with Polish, Mišak et al. 2005 with Croatian

scholars, El Malik and Nesi 2008 with Sudanese scholars, Yakhontova 2006 with Ukrainian and Russian scholars and Pérez-Llantada 2007, Vázquez and Giner 2009 and Pérez-Llantada et al. 2011 with Spanish scholars, among others). These cultural mismatches have been reported to lead to rejection even in the post-publication process, as was the case of a retracted immunogenetics paper written by Spanish and Palestinian researchers – 'wording, thematic development, and clearly marked introductory and concluding moves, rather than hedging' being relevant features to target for revision (Kerans 2002, p. 39). In striking similarity to the self-perceived language difficulties reported by the Spanish scholars, J. Flowerdew (2001, p. 127) explains that textual features such as convoluted grammar or the expression of provisionality through modality markers in discourse are problematic aspects in non-native English contributions and thus have an impact on rejection rates.

Other culture-specific challenges have been raised regarding L2 English scholars' linguistic burdens and issues of domain loss and linguistic imperialism. Englander (2009) reports on the textual deficiencies noted by reviewers in L2 English manuscripts written by Mexican academics. Having their manuscripts revised along the lines suggested by these reviewers, Englander explains that these academics showed awareness of the fact that their particular way of 'thinking in Spanish' and embellishing the style could account for the referees' criticism on language and that, consequently, they had to get rid of these traits to get the paper published. Implicitly, Englander's study brings to the surface how the 'go native' shift may involve loss of culture-specific identities and styles. In this respect, it is interesting to recall at this point that some, like J. Flowerdew (2001, p. 142) with the case of Chinese scholars, report that while some Anglophone editors of English-medium journals tend to be sympathetic towards 'hybridized' English and 'adopt a compromise between maintaining international intelligibility, on the one hand, and the integrity of the nativized variety, where possible, on the other', others are more likely to reject a poorly written manuscript as revising and improving it unquestionably involves time and effort.

Issues of culture and language impact have also been raised by experienced professional translators. Drawing on her own experience as a freelance translator, Berghammer (2008, pp. 214–15) criticizes the weaknesses of journal translation services in a bilingual English-German medical journal since the shift from English into German involved 'unusual collocations (i.e. phraseological units), terminological inaccuracies, unidiomatic phrases resulting from translation word by word, some nuances of the source text were not adequately transposed into the target language'. Berghammer notes that these shortcomings are likely attributed to culture- and language-transfer and that only language revisers and translators aware of both cultures and their languages can successfully solve these shortcomings. In sum, this scholarly work would substantially confirm Burrough-Boenisch's (2002, p. 229) view that shortcomings

with discourse and rhetoric 'might reflect the author's imperfect command of English, but they could reflect a mismatch between what is appropriate in the author's writing culture and in scientific English'.

At present, though, no editorial policies specifically detail issues on language, except for the fact that they consistently advise non-native English writers to send their contributions to an English-speaking language advisor before submitting it to the journal. Few scientific journals provide explicit review criteria and reviewer training that may help in language advising and suitably judging the new rhetoric of globalization. It can be recalled here that the recurrent practice among the UM- and UZ-based scholars participating in peer reviewing processes was one of generalizing on the mastery/poor use of English. Lack of explicit criteria on how to handle language in scientific publication may explain why for the UM scholars poor English was not a rejection criterion while the UZ scholars' experience was that manuscripts would be rejected because of poor use of the English language and/or poor to average quality of the research itself.

Language and, broadly speaking, gate-keeping policies with largely Anglophone journal editorial boards have been seen by some to result in hegemonic practices in that these boards may be favouring those in the core centre as opposed to those in the periphery. Hamel (2007, pp. 60–1) censures the way original research articles 'may get lost or pass unnoticed if they are published in any other language' and, more recently, Harley et al. (2010, p. 12) criticize 'too powerful and/or uninformed editors arbitrating who gets published'. Meriläinen et al. (2008, p. 564) further suggest that

> [. . .] institutions of academic publishing are constantly reproduced through hegemonic practices that serve to maintain and reinforce core-periphery relations between the Anglophone core and peripheral countries such as Finland. The wider academic milieu with its taxonomies of academic performance and journal quality serves to perpetuate these practices. This results in academic researchers from the periphery contributing to 'othering' within the publishing process.

Although at present peer review is consensually seen as the best available system, to some, the current academic merit system (based on number and quality of published articles) may be negatively affecting the primary communicative goal of scientific discourse, that of disseminating new knowledge. Abbot's (2008, p. 30) argument below likewise brings us back to the problem of how to measure good knowledge in a fair way:

> As long as the career system relies on peer-reviewed publication as its final measure of achievement, those publications – and if necessary the subsidies to maintain them – have to continue, one way or the other. But if achievement

> were to begin to be measured by some other performance system – say an online approval voting system – the journals would be in trouble in a hurry, not because subscriptions would disappear, but because submissions would disappear. Put another way, it is at present not at all clear that the communication function of the journals would sustain them independently of their achievement-rating function, particularly in a world where the main ideas are held in common and what matters most is the performance of them.

This, though, remains a matter of conscientious debate.

Having described the challenges faced by non-native English-speaking scientists, a note should be made on ways of coping with language burdens. Hewings (2006) explains that since comments on English language are an important criterion for judging manuscripts, with 60 per cent of reviews (both NES and NNES) commenting on language, particular attention should be paid to these weaknesses, which can be partially overcome with dictionaries and glossaries, online tools and software or with the help of language mediators such as translators, language advisors, even lenient editors, at various stages of the publishing process. Expertise in writing, as also noted by Hewings, may also help overcome these problems. Resorting to sentence templates, that is, employing recurring phraseological chunks in scientific discourse writing is an accepted practice of language re-use (Swales and Feak 1996, Cargill and O'Connor 2009) and it actually turned out to be a common practice among the Spanish scholars surveyed. In a similar vein, a pertinent point raised by Gosden (1995, 2003) regarding the editorial process is the way a novice scholar's lack of confidence – namely, expertise – in handling this process may hinder the chances of publication. Gosden (2003, p. 87, cf. also 2001) explains that the publication process entails 'challenging task of framing effective replies to referees' criticisms, a complex process requiring considerable socio-cultural sensitivity and pragma-linguistic competence'. Like others (Berkenkotter and Huckin 1995, Bishop and Ostrom 1997, Johns 1988, 1997, Paltridge 2002) this author recommends that raising novices' acquaintance with cross-cultural variation in scientific discourse and pragmatic aspects of communication is key to successfully address language-related editorial demands.

Situated Learning and Advanced Literacy Skills

Considering the observations of the previous sections the rhetoric of contemporary science can be said to be crafted within the process-product dichotomy explained in Chapter 3 (cf. Figure 3.3.). From the data gathered in the previous chapter and the comments above on the importance of gained expertise, it is deemed necessary to briefly discuss situated learning, or learning that takes place within a community of practice (Lave and Wenger 1991).

Situated learning appears to play a major role in the acquisition of academic literacies in the current scientific communities. Being familiar with the actual 'sites of engagement' (Bhatia 2004) and aware of the critical moments in which scientists create and construct new knowledge until it eventually begets a form of discourse may result in a more comprehensive view of the latter as both process and product. The disciplinary practices and procedures reported by the sample of scientists in the two cultural contexts lend credence to the importance of novice scholars' enculturation within their 'sites of engagement'. Drawing on the ethnographic data of Chapter 5, several salient aspects of situated learning are commented on below.

Of all the reported practices, the role of the senior academics in mentoring the novices is first and foremost in significance. The senior academics in the two cultural contexts explained that they usually start mentoring the novices when the latter are PhD students. They also stated that they raise their mentees' language-awareness by detailed polishing of drafts of their PhD research. In climbing up the academic ladder and gaining confidence in disciplinary knowledge, the novices usually become first authors in charge of the first draft of the research. The seniors reported that their role was to revise the manuscripts thoroughly, checking for both content and stylistic shortcomings. In addition, showing great concern towards the need to improve competence in academic written and spoken English, they engaged them in reading the literature extensively and in participating actively in research group meetings. Showing particular sensitivity towards plurilingualism in scientific communication, some of the senior scholars from the non-Anglophone context even reported that they recommended that the novices rehearse their paper presentations before attending English-medium international conferences. In short, fostering the novices' participation in these various discursive practices and training them in the confident use of a repertoire of written and spoken genre sets appeared to be an effective means of improving their proficiency level in scientific English as part of their enculturation process in academia.

Another aspect of interest for strengthening the situated learning of the novices relates to the experienced scholars' preferred practices for drafting and improving manuscripts. The scholars used outlines for drafting their papers, wrote several drafts, exchanged them with colleagues or discussed them in research groups. In the process of gestating new knowledge scientists got feedback at conferences and seminars and, in the particular case of some researchers, comments from collaborating with international peer-colleagues. The ethnographic record on academic mentorship also brought to the fore the seniors' advice, drawn upon their own extensive publishing and refereeing experience, on the use of intertextuality and citation. Socially related writing practices such as co-authoring with the juniors in their pre-tenure years to help them get more credit appeared to be a common practice for assisting novices in climbing up the academic ladder.

Across cultural boundaries, research group procedures were specifically oriented towards eliciting novices' critical understanding of those previous texts influencing the current research. Further, the seniors said that they provided the novices with a critical view of who/what needs to be cited and of the promotional purposes of self-citation. Along with these discourse practices, the seniors showed the juniors how to appropriately convey an authorial stance. Casanave and Vandrick (2003) reported similar autobiographical accounts of established non-native English scholars participating in English academic publishing. Another example is Hasrati's (2005) account of Iranian PhD students in UK universities, which lends further support to the scope and significance of mentoring and situated learning.

Situated learning is grounded in situated cognition and experiential learning. It also plays a key role in helping the juniors gain experience in the dynamics of the scientific publishing particularly pre- and post-writing activities such as reading literature, thinking critically, finding gaps, knowing how to raise interestingness of the study in the scientific discourse, ensuring that the scientific discourse falls within the scope of the journal, that its format and layout are those recommended to prospective authors. These were, in fact, some of the content issues that journal gate-keepers tend to criticize, as explained previously.

Beaufort (1998, p. 64) devises a model for 'Five context-specific knowledge domains for writing expertise'. The following four overlap and coalesce to shape an expert text: 'subject matter knowledge', 'rhetorical knowledge', 'writing process knowledge', 'genre knowledge'. All the four can be encapsulated or bounded by what she calls 'discourse community knowledge' (cf. also Swales 2002). It is interesting to note that, when referring to the first stages of the publication process, both UM and UZ scholars reported that initial research findings matured through peer-to-peer informal conversation, lab discussion and research group meetings with sub-disciplinary specialists. The two subsets of interviewees further reported that once the manuscript was drafted they exchanged it with peer-specialists or co-authors in their sub-disciplinary field in order to improve it conceptually, linguistically and stylistically. Only in the case of interdisciplinary research do discipline experts provide specialized data that nurture the initial research ideas and findings with different new ideas, suggestions and even interdisciplinary approaches.

Showing novices how to handle editors and reviewers' recommendations such as the ones described in the previous section of this chapter may become another constructive mentoring exercise to assist them in the intricacies of the publication process of a manuscript. The rule of thumb for both native and non-native novice scholars alike would evidently be to follow reviewers' recommendations and suggestions for improving the manuscript as thoroughly as possible. For those not sufficiently confident with the phraseology and functional purpose of this genre, Feak (2009, p. 32) sensibly recommends,

for instance, that drawing attention to the use of recurrent multifunctional verb choices (e.g. *modify*, *revise*, *rephrase*, *rewrite*, *alter*, *clarify*, *explain*, *elaborate*, etc.) in authors' responses to reviewers may improve the novices' skills in framing their responses. As for potential face-threatening acts involved in authors' responses rejecting reviewers' comments, Feak (2009, p. 27) judiciously draws on Leech's maxims and suggests that writers should minimize dispraise, antipathy and disagreement between self and others and rather focus on what editors are demanding or suggesting for improving the quality of the manuscript. Relying on the seniors' experience, the novices should become cognizant that responses not adhering to these maxims might not meet the editors' expectations or even be considered offensive by unpaid, expert reviewers, generally willing to improve the quality of the journal publications and the quality of the research itself. Therefore, acculturating novice writers in how to provide appropriate authors' responses may lead to a more fluent and convivial interaction between writers and editors. Acquaintance with the expected judgement and counselling goals of referees' reports as well as the defining communicative features of praise, criticism and evaluation of this particular genre type (Fortanet 2008) may make the interaction/collaborative work between writers and journal gate-keepers more effective and eventually successful. The publishing experience of the senior scholars may thus represent a good training activity for the less experienced academics.

As far as language issues are concerned, situated learning elicits novices' awareness of the various types of language mediators (journal editors, reviewers, language revisers and translators) involved in the processes of construction and eventual dissemination of science. In the publication process, awareness of the functions and roles of other types of language mediators is of interest for those initiating their research publishing careers. Journal editors, referees and copy editors all make an important contribution to shaping published scientific discourse. As also widely attested in the literature (Kourilovà 1996, 1998, Benfield and Howard 2001, Burrough-Boenisch 2002, 2003, Steinman 2003, among others), the former play an important role in both improving both content and language aspects of the manuscript. Editors and reviewers' comments on 'language' aspects mainly drew the author's attention to discourse weaknesses (e.g. lack clarity of ideas, incoherent textual flow and improper thematic development) or linguistic weaknesses (i.e. incorrect use of the grammar of English, of the English modality system, excessive verbosity, ambiguity of style). The ethnographic account of Chapter 5 makes salient the role of language specialists, translators, language advisors, journal editors and copy editors. At this point in the publishing process of a scientific discourse, it was the non-native English-speaking Spanish academics, and not their native English-speaking counterparts, that sought the assistance of language specialists such as translators and language revisers – at times occasionally, at other times regularly. Translators did not appear to play a significant role among

the UZ-based subset of interviewees. By contrast, language revisers were in increasing demand, noticeably in the fields of social sciences but also in the engineering, biomedical and physical sciences fields. As reported by the UZ interviewees, the role of these language mediators basically involves revising the manuscript both linguistically and, above all, stylistically. Unfortunately very little information on the role of copy editors was retrieved from the ethnographic study, except for the fact that they made minor stylistic changes that authors generally agree with unless they involved changes or different shades of semantic meanings, hence the varying the intended propositional contents of the manuscript. Awareness-raising of these shortcomings and the mentor/mentee interaction or research group interaction approaching ways of solving them can become a key dynamics in successful situated learning.

Journal reviewing is a regular participatory mechanism in the scientific communication exchange in the global village. However, it often involves no previous explicit instruction or training. Initiating mentees in small-scale reviewing processes and eliciting assessment of content and language aspects of, say, draft, submitted or revised manuscripts may also be an interesting literacy skill to incorporate into the novices' enculturation process, as already suggested by Johns (1988). These aspects may be useful in the long run since when the novices become published authors, they are usually invited to participate in the review process. Acquaintance with the defining aspects of the submission, reviewing, resubmission and editing processes may further invite a fruitful exchange of perceptions in standard vs other multicultural models of communication.

The observations above on situated learning indicate that the scientific community and, more specifically, the variegated academic tribes, are not monolithic and unitary but hybrid. They are characterized by varied values and sub-disciplinary discourse practices and procedures. They hold individuals with diverse academic and research experiences and interests. Further, in the processes of gestating, constructing and disseminating science, they engage with multicultural models of scientific communication and embrace individuals with diverse languages and cultural backgrounds. The following chapter deepens into issues of multiculturalism and plurilingualism as perceived through the lens of contemporary scientific discourse.

Chapter 7

ELF and a More Complex Sociolinguistic Landscape

Glocal Discourses in Scientific Communication

At this point in the volume readers will hopefully have gained an idea of the nature of contemporary scientific discourse in L1 and L2 English contexts. It is expected that readers will also have realized the importance of complementing analytical methods such as corpus linguistics and ethnography to enquire into scientific discourse and into the way rhetorical traditions vary from culture to culture. Bearing in mind the factual evidence provided in previous chapters, the goal of this chapter is to deepen into issues of language and culture in scientific communication in today's research world.

The textual, socio-cognitive and rhetorical features of scientific discourse reflect the existence of commonly agreed standardized norms for transnational scientific exchange. To date, these norms have been based on monolingual assumptions, namely, the Anglophone culture. Conceptually speaking, such norms lie at the heart of mutual understanding and shared communication within and across disciplinary communities of practice (Bhatia 2001, Locke 2001). As attested in Chapters 4 and 5, 'textual regularities derive from the exercise of particular conventions' (Candlin and Hyland 1999, p. 13) for successful communication in science.

Scientific discourse has also proved to be a standard register across cultural contexts and languages (cf. Chapter 4) with regard to the formatting of information. Roughly speaking, the recurring organizational scaffoldings described in Chapter 3 facilitate the transmission of knowledge whenever scientists worldwide contextualize their research and claim significance of findings within their field of investigation. As described earlier, the range of discursive options and language constraints is determined by the specific generic aspects of a given text type. Genres like the research article, the abstract, the research proposal, the PhD dissertation or the grant proposal are shaped by a clear-cut articulation of communicative purposes and style and by a fixed structural embedding of ideas which target at clear, simple and effective communication. Further, the standardized practices utilized for the textualization – that

is, construction and production – of scientific knowledge make manifest variegated disciplinary practices. Even so, the rich variety of ethoi and disciplinary cultures across domain-specific fields in academia falls, in a fairly homogeneous manner, under the label 'standardized scientific English' and its subsequent goal of intelligibility and effective scientific communication.

A further contributing factor to the spread and strengthening of Anglophone standardized practices, as also shown in the ethnographic account in Chapter 5, is the reading and critical thinking activities that scientists conduct in the process of gestating new scientific knowledge which precedes the actual composing of texts. Further evidence is offered by Nicholas et al.'s (2005, p. 253) study on the information seeking behaviour of academics and researchers with regard to digital journal libraries. As these authors report, the standard usage analyses show that 'full text articles proved to be the most viewed items'. This user behaviour analysis indicates that university scholars are the most representative group in accessing domain-specific journal articles and papers. Unquestionably, common agreement in these community procedures fuels the real advancement of scientific knowledge production.

Early definitions of the language of science argued that '[t]he austerity of tone that is characteristic of scientific writing obscures any national differences, and as one reads one almost immediately loses any impression that one is reading the words of an inhabitant of another continent' (Savory 1953, p. 29). In the postmodern age, this view has changed radically. The escalating use of digital technologies and the global transcultural flows of contemporary society encompass new forms of scientific exchange and interdisciplinary collaboration. What Savory (1953, p. 202) referred to as the 'authentic voice of science', with thought and matter prevailing over style, has now shifted towards highly interpersonal and dialogical grounds in order to comply with the socio-rhetorical constraints imposed by the social forces shaping the nature and utility of knowledge. Institutional pressures and the dynamics of research publishing in a competitive context described and illustrated previously in this volume determine to a great extent the way new knowledge is disseminated in today's research world. By way of illustration, in a recent electronic survey of authors/reviewers by a prestigious publishing company, scientific journal authors stated that the overall reputation, the impact factor and the readership profile of the journal were among the most important considerations when submitting their articles for publication. Bearing in mind that writing for publication involves 'an estimated 5.5 million scholars, 2,000 publishers and 17,500 research/higher education institutions' (Lillis and Curry 2010, p. 1), from the authors' considerations above it may be easily inferred that transnational communication of scientific knowledge goes beyond the goals of mere information exchange and science dissemination in the context of such a competitive landscape.

The rhetoric of globalization arises out of increasingly interdependent forms of professional interrelatedness. Among these interdependent forms, as noted earlier, lies the use of English as the lingua franca for scientific exchange, or scientific ELF. While the practicality of such collaboration necessarily demands certain standardization norms it none the less brings to the fore the specific rhetorical flavourings of national-based scientific communities. In the light of corpus and ethnographic data, a proper understanding of globalization in the scientific milieu therefore contests monolingual assumptions informing scientific discourse, its rhetorical practices and pedagogical approaches. As discussed in the following sections of this chapter, it calls attention to the emerging 'glocal' discourses that hybridize the Anglophone standardized norms with their unique rhetorical traits. It shows processes of linguistic borrowing and cultural blending, that recall Yakhontova's (2002, p. 231) reference to 'an eclectic and even eccentric blend of different features in L2 academic writing'. Linguistic borrowing and cultural blending may explain Mauranen and Metsä-Ketelä's (2006, p. 2) observation that ELF in the spoken domain 'is a child of the postmodern world: it observes no national boundaries and it has no definite centers. In many ways, it is part of a transcultural flow, with its speakers using it in their own ways, constructing their own identities and forming their own groupings'.

The hybridized discourse practices in today's scientific communication are the outcome of complex sociocultural, political and economic factors that, as explained earlier in this volume, determine the everyday practices of science communication. While L2 English scientists seek to adapt to standard, readable academic English for scientific exchange, their local L1 discourse features seeping into their L2 English texts sustain the diversity of national cultures. It can thus be argued that current scientific activity embeds national, cross-cultural differences that surface in its discourse practices and texts, eventually giving rise to 'glocal discourses'. As amply evidenced by the contrastive rhetoric field, scientific genres bring to the fore the merging of standard Anglophone rhetorical conventions with the culture-specific rhetorical traditions and intellectual styles of non-native English-speaking scholars. Reportedly, cross-cultural variation can be traced in the textual rendering of texts and in variegated intellectual styles displayed at a discourse level. While scholars in Anglophone-based contexts tend to adhere to the succinctness and linear argumentation of Western rhetoric, those from non-Anglophone contexts display different conventions regarding the expression of modality and evaluation in the discourse and display different intellectual styles in the construction of arguments (e.g. digression in German, convoluted sentences in Spanish, Mexican and Portuguese, etc.).

Anthony Giddens (1999, p. 21) defined globalization as 'intensification of worldwide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa'. It was also argued earlier that the advancement of the ICTs was a key factor in

energizing the phenomenon of globalization, the flow of people and the crossing of cultures and languages, by this means activating new forms of increased interconnectedness. Of note, the 2020 vision of the State of the World Forum refers to 'networking creativity to solve global challenges', a motto which underpins a profound cross-cultural collaborative dialogue with the aim of intensifying worldwide social relations. If we are to postulate that contemporary science is postmodern in the sense that it merges universality and fragmentation, as explained earlier, we should then regard scientific English as a functional variety of English, a language for communication, not a language for identification, 'thus celebrating the "otherness" under the surface of the English language' (House 2003, p. 574). In turn, this 'otherness' should be seen not as a way of resisting the English norms, as postulated by Phillipson (1992), Canagaragah (2002a, b) and others. Rather, it should be seen as a functional variety that targets at effective communication and eventual mutual cooperation for the advancement of science. This perception of scientific discourse displaying both the normative (global) and the local traits for 'world dialogue' necessarily raises discussion on issues of plurilingualism and L2 English multicompetence in the scientific arena of the global village.

'World dialogue' makes the traditional concept of speech communities more complex by introducing a dynamic model of plurilingualism that entails both language and culture competence in a language other than one's L1 language. In using networking and profiting from interrelatedness and cooperation, social groupings across academic and research sites surpass nationalisms and cultural identities. Grounded in the dynamic model of plurilingualism, new spaces for multiculturalism are created in academia. These new spaces lend credence to the existence of variation and diversity of language usage as well as new social attitudes towards languages in academia and languages in the world, as explained below.

The Dynamic Model of Plurilingualism and L2 Multicompetence

Bloomaert et al. (2005, p. 197) analyse the phenomenon of plurilingualism and L2 multicompetence on the grounds of 'the political and historical situatedness of linguistic competence and the centrality of interactional perspectives in social-linguistic analysis'. As reflected in the quote below, these authors implicitly bring to the surface the intrinsic power of languages in contemporary society:

> [. . .] plurilingualism is not what individuals have and don't have, but what the environment, as structured determinations and interactional emergence, enables and disables. Consequently, plurilingualism often occurs

as truncated competence, which depending on scalar judgments may be declared 'valued assets' or dismissed as 'having no language'.

A clear example of the connection between macro-conditions and micro-processes operating in the globalizing context can be seen in the increasing promotion of cultural values and multilingual traditions as valued symbols of identity. The promotion of plurilingualism, for instance, can be seen in UNESCO, the world's leading educational, scientific and cultural organization, which proclaimed in 1999 International Mother Language Day (21 February) with the aim of supporting plurilingualism and developing awareness of cultural and linguistic diversity worldwide. Barely a decade later, in 2007, the International Year of Languages was celebrated under the motto 'unity in diversity and international understanding', with plurilingualism and multiculturalism as the pillars of world cross-cultural understanding. Since then, particular concern for multiculturalism, plurilingualism and promotion of cultural values has endorsed numerous language-related initiatives worldwide targeted at consolidating a cross-cultural dialogue characterized by a multifarious landscape of diverse languages and dialects.

Today's growingly complex linguistic situation calls attention to the development of L2 multicompetence, or competence of an additional language, which encompasses both language and culture competence. In offering a critical review of various foreign language/Languages for Specialized Purposes (LSP) methodologies at present employed in higher education throughout North America, Europe and Australasia, Stadler (2011, p. 281) argues that language instruction should offer 'a broader notion of intercultural understanding in its learners that is applicable independently of a particular cultural context'. This new stance towards languages foregrounds not only the strictly linguistic but also the pragmatic constituents for effective scientific communication. Both aspects are particularly relevant for becoming a proficient communicator in a given domain-specific discourse. It also requires what Tomalin and Stempleski (1993, p. 6) defined as 'heightened awareness of the degree to which cross-cultural communication is affected by culturally related factors'. Both Chapters 5 and 6 gave evidence of the degree to which scientific communication may be impacted by culture and language factors. Such impact in turn raises further concern about two intrinsically related considerations: the surfacing of the dominant culture/language over minority cultures/languages and the emergence of new language learning and intercultural competence needs. As explained below, while the former is shaped and determined by geopolitical and economic decisions, the latter deems it necessary to address the more practical aspects of scientific communication, namely, the pedagogical aspects.

We have seen that contemporary scientific communication is just one part of a broader sociopolitical phenomenon involving the impact of languages and cultures in the contemporary social landscape. While in geographical

regions such as the United States, the United Kingdom, Australia or Asia, the sociolinguistic profile in academia is primarily dominated by English as an L1 (in the case of the former) and as the language for instruction in higher education and research exchange (in the case of the latter), the multilingual European Union stands perhaps as the clearest geographical example of the way the dominant Anglophone language/culture has imposed and continues gradually to impose over minority cultures in academic and research settings. The map of foreign languages in Europe places English at the forefront (representing 38%), followed by French and German (14% each) and then Italian, Spanish, Polish and Russian (European Commission 2006, p. 7). In academia and research contexts, as described earlier in this volume, scientific ELF is the target language for academic instruction and research exchange in outer circle countries. It will become the language of instruction in higher education institutions, and clearly the language of research exchange, in countries belonging to the expanding circle if policies such as staff and student mobility across institutions and projects under the European framework programmes continue.

Underpinning contemporary scientific discourse, L2 multicompetence and its ensuing rich linguistic diversity are sustained upon the use of ELF for transnational and, hence, intercultural communication. The growing creation of multicultural spaces in and across research sites, English being always the shared medium for communication, is dramatically changing the perceptions of one's own and others' nationalisms and cultural identities. Awareness of the domains where ELF as the target language operates stimulates discussion on language attitudes, as also reported in the ethnographic chapter. For some, scientific ELF as a target language establishes constraints in different areas of intercultural communication (e.g. from business and economics to the scientific domain). For others, practicality in the use of a target language is related to engaging in successful communicative performance rather than maintaining an identity or establishing an attachment to a given community.

Appreciation of multiculturalism has in turn developed increased interest in plurilingual competence – in the particular case of academia, L2 English competence. It has been convincingly argued that transnational scientific exchange involves not only language skills but also acquaintance with cultural differences and different behaviours, values and beliefs (Stadler 2011). In advocating cultural differences in the contemporary scientific milieu, Mauranen (1993b, p. 157) defines the competent intercultural communicator as one whose texts display several culture-specific rhetorical features, most of them above sentence level. This author further concludes that 'the native culture provides default rules for those aspects of text production that we are not usually conscious of but which shape our perceptions of convincingness in an important way'. What J. Flowerdew (2002, p. 294) refers to as 'preferred expectations about how information is organized in different languages and cultures' has

also been shown to apply to L2 English scholars from geographical sites as varied as Slovakia, Russia, Finland, Germany, the Netherlands, Norway, Hungary, Poland, Bulgaria, Romania, Italy, Portugal, Spain and across South-America and the Asian and African continents as well.

In addition to language competence, intercultural competence for transnational cooperation is a pillar of scientific communication and hence awareness and acquisition of the pragmatic aspects of languages are desirable. In addressing L2 multicompetence in general, Byram (1995, pp. 115–16) also characterizes a competent intercultural communicator by stressing the link between language and culture issues:

> An intercultural speaker is someone who can operate their linguistic competence and their sociolinguistic awareness of the relationship between language and the context in which it is used, in order to manage interaction across cultural boundaries, to anticipate misunderstandings caused by difference in values, meanings and beliefs, and thirdly, to cope with the affective as well as cognitive demands of engagement with others.

The value and growing perception of plurilingualism across the contemporary multicultural scientific domain develops from the recognition of world dialogue between cultures and, as far as concerns the present volume, of scientific communicative interactions aimed at building up professionalism for the sake of scientific development itself. Preserving culture-related identities and scholarly traditions should not only be considered a kind of 'local resistance' (Gotti 2005, p. 139) to the globalizing trend, but also as a way of claiming 'greater recognition of the role of non-Anglophones in that Englishized world' (Swales 2004, p. 46). Subscribing to Dewey's (2007) view, one would conclude the rhetoric of contemporary scientific discourse reassesses cultural diversity and foregrounds the diversification of ELF users that research in contrastive rhetoric, applied linguistics and EAP has comprehensively described.

Indeed, a consideration of the diversification of ELF as a sign of multicultural diversity in academia makes it relevant to address here some general pedagogical points. Today, an all-encompassing knowledge of language and culture becomes a requirement in foreign language learning in general and LSP learning in particular. On a worldwide scale, and in university contexts too, there is noticeably increasing concern with the use of standardized indicators for measuring both the language and the intercultural competence of users. The Common European Framework of Reference in Languages (CEFRL) was initially conceived of as a means of homogeneously measuring language competence according to six existing levels: basic user (A1 or *Breakthrough*, A2 or *Waystage*), independent user (B1 or *Threshold*, B2 or *Vantage*) and competent user (C1 *Effective Operational Proficiency*, C2 or *Mastery*). The CEFRL stands as a crucial base for formulating charters for testing and certifying language and

intercultural competence of learners worldwide. Theoretically, these aspects guarantee multicompetence on equal grounds and the philosophy certainly promotes the innumerable advantages of polyglotism. Presumably, though, underpinning these pedagogical concerns also lie the economic interests of the big businesses of language services and language assessment services that cater for the general and specialized language needs resulting from the social and transcultural flows in which contemporary societies find themselves.

Pedagogically, intercultural competence is now becoming an integrated component of the actual language learning process. Candelier (2007) includes useful descriptors and guidelines for an integrated didactics of language knowledge, attitude and skills. These new 'winds of change' in foreign language pedagogy proclaim that learning the language should entail becoming familiar with the cultural manifestations of the language (cf., e.g. Commission of the European Communities 2008, p. 6). This seems a reasonable approach since, after all, languages are intrinsically linked to the literature, history, art, culture and society of every country/region. But again, geopolitical and economic interests appear to be underpinning these initiatives for the sustainable development of multilingual societies (e.g. by overcoming language barriers in local environments) and for empowering cooperation and social cohesion as a way to strengthen people's mobility, competitiveness and employability in the market (cf. Commission of the European Communities 2005). In the domain of academia, they may be seen as part of university policies to favour internationalization and by this means increase institutional visibility worldwide. As Alcón Soler and Safont Jordà (2008, p. 23) likewise remark, current initiatives on polyglotism and plurilingual education as motors of intercultural dialogue are 'open to political influence, which in turn is determined by transnational and national geopolitical visions'.

From Linguistic Imperialism to Diversification in ELF

Earlier in this volume we referred to the more complex sociolinguistic landscape resulting from the global expansion and predominance of English in the context of global multilingualism (Kachru 1986, Crystal 1997, Graddol 1997, Widdowson 2006). It was also explained that according to Berns's concentric circles of European Englishes (1995, p. 9) while the so-called inner circle formed by English-speaking countries remains unchanging, the outer circle of postcolonial countries and the expanding circle are changing significantly the linguistic mapping. From the facts reported in the previous chapters, the same trend seems to be taking place in contemporary academia, both in Europe and elsewhere.

In the scientific domain, English has expanded as part of the scientific and economic developments in the Anglophone world in the past 150 years and has

now consolidated its status as the lingua franca for scientific exchange. The expanding circle of English does not only encompass a stable situation in biliterate university environments in countries like Finland, Sweden, Denmark or Norway (cf., e.g. Gunnarsson 2001, Murray and Dingwall 2001, Petersen and Shaw 2002, Ljosland 2007) but is also attracting a growing number of countries worldwide that are increasingly utilizing English in different domains – mainly education, research and business – as a key strategy in their process of internationalization and competitiveness, as well as increased international collaboration and recognition. In Asian countries such as China, Japan, India and South Korea, English is also the main medium of instruction for facing the challenges of competition in the world marketplace of higher education and for seeking international recognition for research and innovation (Altbach and Umakoshi 2004).

As for its written mode, normative scientific ELF discourse, fairly standardized as seen before, is the result of 'a trend that has taken place over the 20th century as part and parcel of a more global language shift process in the international arena of scientific publication' (Hamel 2007, p. 54, see also Uzuner 2008). Linguistic imperialism has been claimed to lead to domain loss (Haberland 2005). We are witnessing how scientists are shifting to English for publication to reach the international forum and, as the Spanish scholars expressed in the interview protocols gain, greater recognition and prestige in the international community (cf. also Lafuente 1996). But even if linguistic imperialism may be leading to attested domain loss, Hamel draws attention to the existence of international scientific and research fora outside English such as Association des Universités Fracophones (AUF) or the well-known Latindex database of scientific publications in the social sciences and in the humanities. Both fora are specifically ascribed to a language other than English – French and Spanish respectively in these two instances (cf. Hamel 2007, pp. 62–3). Both fora represent, as explained in a later section in this chapter, alternative geopolitical spaces. But understanding linguistic imperialism in the context of scientific research is not just a matter of acknowledging the predominance of a given language (in this particular case, English linguistic imperialism) over minority languages in a global multilingual landscape. It is also a phenomenon that concurrently raises awareness and develops attitudes towards the way the target culture is different from minority cultures and distinctive in itself.

Grounded in post-structuralist doctrines postulated by Foucault, Said, Derrida, Spivak and Lacan, postcolonial critical theory draws attention to the geopolitical foundations of post-colonialism as problematizing the concepts of cultures and national identities by adding new concepts such as transculturality and transnationality and the subsequent construction of hybrid spaces (cf., e.g. Spivak 1990, Said 1993, Ashcroft et al. 2001). Put simply, the postcolonial intellectual discourse recognizes diversity and heterogeneity across foreign cultures. In offering a critical review of colonial dominance, the rhetoric of

identity comes to the fore as a major effect of the globalizing processes. As argued by Storey (1993, p. 92):

> Language-use and cultural practice generally, is seen as 'dialogical', in dialogue and potential conflict with other uses of language, other cultural texts and practices. In this sense, discourse is inseparable from power. Discourse is the means by which institutions wield their power through a process of definition and exclusion.

Evoking this intellectual discourse, Ferguson (2011, p. 15) explains that 'while the new post-colonial Englishes are spoken by relatively stable, national communities of users, this is less clearly true of ELF whose users are highly heterogeneous in national background, L1, purpose and proficiency'. The identity of ELF in scientific communication is linguistically and discoursally hybrid, diverse and heterogeneous, both in the written as in the spoken mode. Even if it relies on established normative models, it proves to undergo, as explained earlier, processes of linguistic borrowing and cultural blending at a discourse level.

The geopolitical advancement of scientific ELF as a target language in the scientific arena explains recent attitudes advocating the need to preserve cultural identities across transnational contexts. Bennett (2011, p. 24, cf. also 2007), for instance, uses the term 'epistemicide' to refer to the 'destruction' in the translation process of 'the epistemological infrastructure of the original work in order to ensure acceptance by the target culture'. Removing traces of the culture-specific epistemic identity when translating a Portuguese academic text into English entails, as Bennett explains, the eventual loss of the rhetorical conventions of research communication in the humanities and the social sciences. But the epistemicide phenomenon may even take place in the dominant language. Berghammer (2008, p. 215), in comparing a specialized source (English) text with a target (German) language text, noted that the translation process of a scientific manuscript may result in 'unusual collocations and unidiomatic translations', 'terminological inaccuracies', 'nuances lost in translation' and eventual 'loss of cultural diversity'.

Adopting the Anglophone normative conventions for reasons of practicality, for example, access to and active involvement in scientific communication, regardless of the reported disadvantages found by non-native English-speaking academics, appears to prevail over attitudes in favour of culture-specific minority traits. The widespread use of ELF as an additional language has been shown to be advantageous in the scientific and research domains in that it allows non-native English scientists to transcend the national and aim for transnational communication in English-medium journals, international conferences and many other types of peer-to-peer networking interactions. In other words, the functionality of scientific ELF nurtures the 'go native' trend

in an English-only research world. As Bennett (2011, p. 129) concludes in the case of Portuguese academics,

> The overwhelming impression, then, is of an academy that is under pressure to change its traditional habits in order to become more acceptable to the outside world. These authors are trying to inculcate the hegemonic values to their students, while at the same time retaining a degree of distance on the issue, attempting wherever possible to reconcile aspects of the traditional discourse with the requirements of international style.

Amidst the linguistically standardized and discoursally diverse nature of contemporary English scientific discourse, reconciling specific discoursal traits of minority discourses with those of the normative discourse does not only require language and intercultural competence on the part of non-native English-speaking scholars. Cultural diversity, regarded by some as a stigmatization phenomenon among peripheral academics from non-Anglophone contexts, may yield some constructive stances. First, it sensitizes monolingual Anglophones to the diverse nature of contemporary ELF in science communication. As shown by the Michigan scholars, it requires intercultural sensitivity, that is to say, sensitivity and respect towards the cultural and linguistic diversity of ELF, both in its written and spoken modes. The second outcome is awareness that such sensitivity towards non-Anglophone uses of scientific ELF should be spread to all facets of academic activity, and perhaps even chartered in some way, in decisive gate-keeping processes of journal editorial boards, or scientific committees for selecting conference abstracts or, perhaps more simply, individuals judging conference presentations by non-Anglophone scholars. Acceptability to the outside world and, more specifically, issues relating to non-Anglophone scholars' (in)equities are raised in the following section.

Scientific ELF: Threat or Opportunity?

ELF in written/spoken scientific communication is a subject of contentious debate as it is difficult to affirm categorically whether it is a threat or an opportunity for those non-Anglophone scholars and researchers worldwide participating in international scientific exchange. There are a number of reasons that may indicate that ELF is a threat. As widely reported by the literature, ELF is a linguistic burden and an obstacle to non-English scientists for accessing information and for disseminating new knowledge. The advancement of ELF also entails degrees of domain loss, as the predominance of English represents a threat to the existence and development of minority languages and cultures in scientific communication. ELF, as argued earlier, may also involve the epistemicide of culture-specific intellectual traditions. Conversely, there are also a number of reasons why

ELF is considered an opportunity. Scientific ELF offers an opportunity for peer-to-peer scientific exchange and allows communication with the international community. ELF also illustrates a rich variety of culture-specific traits and rhetorical traditions among its users. Further, it awakens sensitivity towards minority languages and multicultural communication and raises subsequent concern for specific language policies. It consolidates polyglotism and raises awareness of the value of multicompetence, plurilingualism and intercultural competence. Arguments in favour and against ELF are further discussed below.

The dominance of English in scientific fora and the spread of science in English-medium publications through digital technologies is an obstacle for peripheral scholars when accessing information (cf. Salager-Meyer 2008), an obstacle motivated by the existing geopolitical core centres. ELF itself, and not just lack of access to electronic resources, has also been described as an obstacle for accessing information. In today's research world it is essential to keep track of current publications, and most of them are written in English. These publications are not available in minority languages and are most of the times available electronically. This has created a distinction between English language centre scholars and scholars from the periphery or 'off-network scholars in the global research community' (Belcher 2007, p. 5). Meriläinen et al. (2008, p. 564) stress the excessive Englishization of current scientific activity (research practices) and criticize that

> [. . .] institutions of academic publishing are constantly reproduced through hegemonic practices that serve to maintain and reinforce core-periphery relations between the Anglophone core and peripheral countries [. . .] This results in academic researchers from the periphery contributing to 'othering' within the publishing process.

As for issues of domain loss, it is true English is gradually becoming mandatory in international scientific communication. It has impacted the domain of scientific publications, with journals switching to English in order to reach a wider audience. As a result, the predominance of ELF causes the demise of non-English-medium journals. Scientific journals consequently involve greater competition and pressure to publish at an international scale but, as regards scientific dissemination, they enable academics to reach wider, and at times highly specialized, audiences with perhaps more human and financial resources for research and much easier access to information sources. By way of illustration, Giannoni (2008, pp. 99–100) describes the case of medical research publications:

> PubMed was then probed for parallel variations in four European languages (Italian, French, Spanish and German) during the same period. The results show a dramatic decline of their overall share, which fell to 3.8%

> of all PubMed entries in 2005 from 9.9% in 1986. Turning to the number of entries for each language (Fig. 3), it is worth remembering that while Spanish saw a slight increase (15%) in publications, the figure is down 12 per cent for French, 40 per cent for German and 60 per cent for Italian. As this dramatic erosion is not a result of decreasing productivity on the part of non-Anglophone medical researchers, the phenomenon graphically illustrates their gradual shift to English over the last two decades.

Another negative effect of scientific ELF relates to the pressure to publish in English-only journals. As argued by Gunnarsson (2000) with the case of Swedish science research, increased publication of research in English indeed threatens publication and the necessary scientific dialogue and exchange in the local languages at a local, national level – what was earlier referred to as social framing contexts 4 and 5 for intranational scientific communication (cf. also Chapter 3). Finding ways of preserving these communication channels in a 'publish in English or perish' world requires discussion, not just for the sake of preserving the local language but also for the social welfare implications on a national scale.

In parallel to the undermining effects on the prestige of scientific publications and conferences held in local languages, the advancement of ELF has also been described as a threat to the existence and development of minority languages and cultures. If we take again the case of the spoken domain (Mauranen et al. 2010a, Mauranen 2011), ELF relegates the local languages to a lesser role. The effect of such displacement may indicate a first step towards global diglossia – and in some regions such as Hong Kong, triglossia (cf. Poon 2010). ELF in scientific and research communication is neither static nor monolithic, it is a language shaped by non-native users of English.

A quick look at the literature reveals, for instance, contentious debate and controversial views on the possible linguistic inequalities and language disadvantages faced by non-native English-speaking scholars. This situation has been labelled 'stigmatization' (Goffman 1986, J. Flowerdew 2008, cf. also Casanave's 2008 interesting alternative view). Writing up research in English as an L2 does not only involve not using poor language quality – for example, including errors in grammar, spelling or language usage – but also adapting to the Anglophone standard norms in terms of lexicogrammar, information organization and rhetorical constraints. Ammon (2006, p. 19) also argues that 'very often native writers of English find it easier than non-natives to have their work published, even if their contribution adds little to the field, just because they are capable of formulating their papers in mainstream conventional discourse styles'. Elsevier's guide to publishing in scholarly journals advises authors that 'poor language quality – including errors in grammar, spelling or language usage – could delay publication or could lead to outright rejection of the paper, preventing the research the recognition it deserves'.

But the debate on good quality of science and correct language, essential features for acceptance of a research paper, a PhD proposal or conference abstract, is more problematic than that addressed by stigmatization issues. For instance, in addition to content and language issues, failure in the communication of new knowledge can also be attributed to premature submission of research to scientific gate-keepers. If one considers the current pressure to publish in English-medium journals, rejection of proposals is an obstacle for scientific output measurements and may eventually have negative effects on academic careers and on equal participation in the international arena. As Casanave (2008, p. 265) observes, 'this pressure can cause L1 and L2 authors alike to prematurely submit a piece that needs editing for language problems' or, in Leki's words (2003, p. 108), make authors submit research still 'undertheorized and underanalyzed'.

Finally, the predominance of English represents a threat to the existence and development of minority languages and cultures in scientific communication. ELF, as argued earlier, may involve the 'epistemicide' of culture specific intellectual traditions and thus raises awareness of loss of identities resulting from the 'go native' trend – that is, the adoption of the Anglophone normative conventions for the sake of acceptance for publication. This was also the case, as mentioned earlier, of Englander's (2009, p. 35) claims on the 'transformation of the identities in the process of revising non-Anglophone (Mexican) scientists' manuscripts according to the recommendations provided by Anglophone journal gate-keepers.

Counterbalancing the claims of threats, ELF certainly offers opportunities for peer-to-peer scientific exchange, communication with the international community and recognition and prestige for scientists, particularly those on the periphery. Active participation in core scientific centres involves deperipheralization. From a linguistic viewpoint, another advantage of ELF is that it illustrates a rich variety of culture-specific traits and rhetorical traditions among its users. A specialized contrastive corpus such as SERAC confirms the existence of different culture-specific linguistic preferences, rhetorical traits and intellectual styles, thereby offering evidence that national identities are still preserved in non-native contributions. After all, we should not forget that all the SERAC texts have been published in high prestige journals irrespective of these national traits.

ELF in contemporary scientific communication also awakens sensitivity towards minority languages, plurilingualism and multicultural communication. One way to enable novice academic writers to find their way in the 'publish or perish' world is for us to accept wider varieties of expression alternative to standard academic English. These varieties account for hybrid lexico-grammatical constructions, certain impoverishment of expression or lack of richness of expression, variegated levels of authorial visibility and different constructions of dialogic spaces for writers/readers interaction. Rhetorically (cf. Aristóteles 1998, Allen 2007), variation in ways of handling accepted opinions (*endoxa*),

constructing arguments (*logos*) and persuading readers (*pistis*) indicates that in the context of globalization, scientific dissemination practices embrace rich diversity in peer-to-peer scientific and research communication.

In the age of plurilingualism and multiculturalism, scientific ELF, far from being a prescriptivist monolingualism, may even be seen as a linguistic handicap for monolingual speakers, as some of the UM scholars noted. This alternative view may support Francophile complaints about the increasing use of English by French scientists for international publication. As Garfield (1989, p. 12) observes in this respect, '[i]t is the complacently monolingual English-speaking world that needs to worry. By not learning foreign languages, it risks being left out of the conversation in an increasingly global and multilingual business community'.

Adhering to Casanave's (2008) view, the 'stigmatization' label oversimplifies the way dichotomies such as nativeness/non-nativeness, core/peripheral participation in science, dominant/minority languages and normative/hybrid discourses simultaneously affect the perceptions and attitudes towards scientific language use across the sociolinguistically complex spaces created by increasing transnational, cross-cultural scientific communication in the global village. In view of the number of factors operating in contemporary science dissemination, it is difficult to make clear-cut generalizations on the opening or closing of doors that ELF brings about in scientific cooperation and exchange. Since ELF stands as the forefront target language in scientific communication, language planning and language policy suggestions are briefly addressed below.

Issues on Language Planning and Areas of Linguistic Intervention

In response to the global and local synergies encompassing cultural diversity of cross-cultural communication, institutional, political and intellectual decision makers have made issues of language planning their major concern. As part of large-scale language planning recommendations, UNESCO's General Conference on 'Implementation of a language policy for the world based on plurilingualism' held in 2003 recognized the need to devise language planning policies to face the global communicative challenges of contemporary societies and their peoples. In a sense, the conference envisaged almost a decade ago the increasingly complex sociolinguistic landscape: the threats that languages, and the English language in particular, impose on some of the users in the context of globalization and its subsequent effects, such as domain loss for minority languages, a risk of losing cultural and linguistic heritages and questions of equity, in particular, access to information resources and access to language learning resources and services.

A descriptive account of normative scientific English in its written mode, as discussed earlier from a range of perspectives and approaches, corroborates Dewey's (2007, p. 347) perception that '[t]he success of any lingua franca depends on certain levels of *stability*, which must entail sufficient *core areas of the grammar and lexis* to serve the purposes of intercultural communication' (my own emphasis added). In this respect, a genre-based pedagogy focused on the interrelatedness of the textual (i.e. lexicogrammatical), the socio-cognitive and the contextual layers of discourse analysis as proposed by Bhatia (1993, 2002a, b) may cater scientific ELF users with suitable communication strategies for intelligible and effective information exchange in the scientific arena (cf. also Johns 2002). Reported alternatives to the current lack of codification of ELF for learning written/spoken academic and research communication range from seeking the advice of native English speakers, using the services of language translators and editors or 'consultation with a more accomplished and language-savvy member of his research team' (Englander 2009, p. 49).

As far as linguistic research is concerned, systematic characterization of core scientific English features (i.e. codification of academic ELF) may facilitate in the future methodical longitudinal and diachronic analysis of whether idiosyncratic features in texts produced by non-Anglophone scholars are static or dynamic. In addition, codification of ELF could be a source of informed data on what Ammon (2006, p. 26, see also 2000) defines as 'globalish', namely, a 'multicentric language encompassing the different varieties of English used by non-native English'. Further, codification may facilitate linguistic examination of whether or not 'globalish' eventually develops into a new set of homogeneous language standards for international scientific communication. The same would apply to spoken ELF, still in need of detailed descriptive accounts like those already reported by Mauranen (2005), Seidlhofer (2001, 2005), or Jenkins's (2000). Jenkins's defines LFC (Lingua Franca Core) as an emerging but still unformed multicentric language. While varieties of academic English seem to be converging in a single multicentric variety, defined as spoken ELF, in the written domain multicultural varieties rather tend to show divergence from the monocentric Anglophone standards, eventually reflecting the myriad of cultures and languages participating in transnational scientific English-medium communication. In learning ELF, Ferguson (2011, p. 21) proposes that 'once adequately informed, learners can be left to decide for themselves whether they wish, or need, to be taught a variety that conforms to traditional L1 standard norms or alternatively forms and ways of communicating in ELF contexts, or possibly both'.

In aligning with Kachru's (1985) broader claims, this pedagogical proposal takes for granted the notion of EFL as a non-restrictive English language usage. In order to put this measure into practice it would be useful to implement a corpus-based and/or corpus-driven instruction using contrastive L1 vs L2 English corpora and L1 native language corpora as a reference

framework. This approach may further facilitate EAP instructors to raise scholars' awareness of standardization but also of diversification in discourse practices. Further, it can invite them to decide, depending on their specific communicative needs or wants, whether they prefer to follow the standard norms or adhere to the rhetorical preferences and intellectual styles of their own scholarly traditions.

Alongside these pedagogical proposals, further areas of educational intervention are germane to a scientific English learning approach sensitive to multicultural scientific communication. One possible area of intervention may involve complementing language instruction with an academic literacy approach, as discussed in the last section of this chapter. This approach can raise learners' awareness of the notions of discourse communities and communities of practices so that they gain a clear understanding of the range of factors that shape the 'interpersonal tactics' of scientific genres (Lorés-Sanz et al. 2010, p. 32). Developing an understanding of the social factors shaping the repertoire of genres should necessarily be accompanied by gained insights into the actual processes of textual production and dissemination of science. As depicted in Chapter 5, the practices and processes in the different subdisciplinary tribes and territories are strikingly similar across cultural contexts, both Anglophone and non-Anglophone based alike.

A further area for pedagogical intervention is concerned with the role of language in language teacher education and, considering the scope of this volume, the role of language in EAP teacher training and education. Implications of the role and function of ELF for language teaching models and language policies deem it necessary to foreground the 'crucial and productive role that consciousness of language plays in the language learning process' (Trappes-Lomax 2002, pp. 2–3). Sifakis (2007, p. 358) advocates a 'truly transformative approach to ELF teacher education', one foregrounding 'the importance of standard English, the role of native speakers and the negotiation of non-native speakers' identities in cross-cultural communication'. Teacher training grounded in this transformative approach may truly sensitize EAP instructors towards the importance of providing learners with input including excerpts of authentic lingua franca communication in the spoken domain, and exposure to contrastive analysis of native and non-native English language use across a representative repertoire of scientific genres in the written domain. This may guarantee learners' understanding of scientific ELF discourse as a textual end-product and of the processes involved in the construction of such textual end-product.

Other pedagogical suggestions that have been shown to alleviate the reported linguistic burden of non-Anglophone scholars are apposite aspects of language planning in the multicultural scientific arena. For instance, manuscript editing has proved to be pedagogically successful (Mišak et al. 2005) in raising awareness of both content aspects (i.e. inappropriate methodological

approaches, incomplete data, insufficient or inappropriate literature review) and language aspects (i.e. clarity of style and proper use of English, lack of consistency in the flow of ideas, weak development of argumentation and inappropriate projection of authorial visibility onto the text) – the latter having been described as the most recurrent shortcomings of L2 English scientific discourses. Indeed, using a genre-based approach to learn scientific English does not only raise awareness of the repertoire of research genres but also of their normative content and language features. The genre approach can also facilitate exposure to linguistic and rhetorical variation of self-expression, the expression of critical views and the projection not only of a disciplinary culture but also of a national culture.

Last but not least, an important issue relating to codification is the so-called language-literacy continuum in scientific communication. This continuum forms a composite grid that includes different scales of proficiency in written and spoken communication and different degrees of competence in general English and in academic English. Without a grid combining language and literacy competence levels, it is difficult to make generalizations on the extent to which scientific ELF is an actual burden to non-native English-speaking scholars. In using a language-literacy continuum grid, teachers can identify the weaknesses of each individual learner and conveniently cater to the learner's specific language and/or literacy competence needs. The literacy approach, deeply rooted in the North-American educational context but unfortunately rare in some areas of the continental context, is appropriate for non-native English-speaking writers as it offers 'a richer and more complex approach to the writing process, one that takes the genre, the writer's role and interests, the audience, the situation and other factors into consideration at the beginning of – and throughout – the process' (Johns 2003, p. 316). This aspect may then need careful consideration on the part of language policy decision makers and educational institutions.

Scientific ELF and Alternative Geolinguistic Spaces

It goes without saying that in the age of globalization scientific dissemination demands a global language with a certain level of stability and uniformity for the sake of common understanding and intelligible scientific knowledge exchange. In the context of scientific writing for publication, '5.5 million scholars, 2,000 publishers and 17,500 research/higher education institutions' (Lillis and Curry 2010, p. 1), as stated earlier, are significant figures reflecting the major role of scientific English worldwide. As discussed earlier in this volume, the scientific community operates on the basis of mutual cooperation and intercultural understanding in order to combine efforts for the advancement of science. As a response to these communicative demands, English has

been appropriated by non-native English-speaking scientists around the world who use it as a second or additional language with the aim of communicating knowledge, cooperating internationally and sharing science in order to move the field ahead.

Geopolitics and the predominance of a hegemonic language do not suppress the role of other languages operating in the scientific domain. Graddol (2006, p. 87) describes the theoretical discourse of English as 'probably the most radical and controversial approach to thinking about English under globalization'. Consistent with Graddol's view, an examination of the theoretical discourse of scientific ELF brings to the surface the existence of alternative geolinguistic and geopolitical forces in maintaining other languages alongside the predominant role and function of English for transnational scientific communication. These alternative languages also operate, for various reasons explained below, for transnational communication and scientific dissemination across cultural contexts.

In the scientific domain, several lingua francas have emerged over the years as a result of the political and economic hegemony of a given culture at a given period of time. As vehicular languages, they have dominated the sociolinguistic landscape of academia by embracing the tenets of universality and flexibility. This was the case of Greek and Latin in early times, later to be replaced by French and German in the late nineteenth and early twentieth centuries until the sociopolitical and economic influence of first the British empire and later the US economy gradually caused English to become dominant in all major spheres of worldwide development – politics, economy, commerce, science, technology and education.

Facts and figures indicate that English is the most widely used language in the scientific domain. In a bibliometric study based on the Chemical Abstracts Service (CAS), Sano (2002, p. 46) compares the evolution of English for scientific communication over a 40-year time span. While in 1961 English was the language of 43.3 per cent of the Chemical Abstracts Service, in the year 2000 it accounted for a total of 82.1 per cent of all abstracts published in this database, with Russian, German, French and Japanese comprising the remaining 17.9 per cent. In 1997, the Science Citation Index already registered a total of 95 per cent of its publications in the English language. At present, the dominance of English in knowledge gateways and platforms such as the SCI Web of Science, SciSearch, Science Citation Index Expanded or Thomson Reuters Journal Citation Reports, comprising thousands of scientific journals across all disciplines, is remarkable as is the escalating number of non-Anglophone contributions in these scholarly publications.

The stability of scientific English as a lingua franca is the result of the current 'increased interconnectedness' (Dewey 2007, p. 337) which, as also stated earlier, is assisted by the advancement of digital technologies and strengthened by increased transnational knowledge exchange. A total of 2,000 million

people use English in the political, commercial, scientific, technical, cultural and educational fields. This type of interconnectedness is particularly useful for those whose 'individual linguistic and rhetorical competence alone are usually insufficient for securing publication in English-medium journals' (Curry and Lillis 2010, p. 281). In networking with native English scientists, non-native English scientists state that they can cope, at least partially, with the language burden. Alongside the dynamics of increased international networking, recent institutional decisions in the context of higher education and research institutions have stimulated the advancement of academic English worldwide. Today, publication of research in high impact factor indexed journals is highly valued in every university's evaluation system (cf. also Curry and Lillis 2004, Lillis and Curry 2010). In the particular case of academia it is therefore not difficult to predict in the long run the leading status of English as the lingua franca for scientific communication. Academic ELF will continue to expand if one considers the increasing proliferation of academic ranking systems (Adler and Harzing 2009) and the current competition among higher education institutions in search of international recognition to attract both foreign students and external funding. In sum, scientific ELF is sociolinguistically responsive to the contemporary interconnectedness of research networks within the scientific arena.

In the past few years, the geolinguistic dominance of English has also been supported by institutional pressures fostering the dissemination of scientific knowledge at an international scale and promoting joint research enterprises and networks. In the context of scientific dissemination, it is worth noting the growing interest that Cordis, the gateway to European research and development, attaches to effective communication. It recommends that 'scientists should be given training in communication skills, taking into account the need for public dialogue, debate and inclusion in decision making' (Bettercourt-Dias 2007, p. 72). Underpinning the recommendations and action plan lies a necessary partnership of 'scientific academies and learned societies' and 'professional science communicators', thus opening a new window to the crucial collaborative role between EAP specialists and scientists.

However, as argued earlier in Chapter 3, not all scientific communication is English medium at a transnational (global) scale. In today's research world the predominance of English cannot disregard concurrent social framing contexts in which scientific discourse is produced and received. While scientific ELF largely controls the contexts of transnational disciplinary and interdisciplinary communication, the local national-level languages of every single country obviously govern interdisciplinary and discipline-specific communication at a national level. Communication at local and intranational levels and, in some cases, at a transnational level, thus brings to light several alternative, concurrent geolinguistic spaces in which minor-scale languages operate. Despite being minority languages they are significant for their impact

on contemporary science. The roles and uses of languages such as Spanish, Portuguese, French and German are in need of empirical and theoretical discussion so that greater attention can be placed on the geolinguistic dimensions of these minority vehicular languages in communicating science worldwide. Though in terms of science these languages have a completely different status to that of English, they none the less play a key role in the discourse practices and communication procedures conducted in some geographic areas of scientific activity. A brief sketch of the impact of these languages in scientific knowledge dissemination is provided below.

Scientific Spanish is of particular interest for understanding the geopolitics of languages in the scholarly context. The status of Spanish as a major world language is undeniable (cf. Silva-Corvalán 1995). At present the Spanish language involves '600 million speakers in the world and with influential historic, artistic and cultural roots' (Parodi 2010, p. 8). Spanish is institutionally supported by the Spanish Royal Academy of Language and also actively promoted by the Cervantes Institute not only in Spain and South-America but also in countries experiencing important socio-economic and demographic development such as Russia, Brazil and Sub-Saharan Africa (Instituto Cervantes 2010). In addition to being a lingua closely attached to a historical and cultural heritage, Spanish is also the vehicular lingua in academia in the Hispanic world where it performs a major role as 'an instrument for international collaboration in higher education'.

The status of Spanish as a vehicular language for scientific communication enables researchers' participation in transnational networks and collaborative research enterprises, and helps maintain institutional exchange between Spanish and Latin American higher education and research centres through EU programmes such as ALAMED, INCO or ALFA or the Spain-based AECID and Fundación Carolina (Acosta et al. 2003). Also, playing a key role in maintaining the historical links between the two sides of the Atlantic, exerting a major impact on international research collaboration overseas and supporting humanistic and social knowledge, the Miguel de Cervantes virtual library provides digital bibliographic access to Spanish and Hispanic researchers, and serves as a solid institutional support for scientific Spanish. In addition, digital repositories of science such as IBERORED (Red Iberoamericana de Bibliografía de las Ciencias de la Medicina y la Tecnología) and DICE, a major journal repository of Spanish publications in the Humanities and Social Sciences, contribute to the maintenance of scientific exchange in the Hispanic world. Perhaps the most widely recognized initiative is Latindex, a major platform of databases that compiles scientific scholarly publications for regional cooperation and science dissemination among Latin America, the Caribbean, Spain and Portugal. Other significant data of interest confirming that the geopolitics of scientific Spanish is on the ascent is the growing number of Spanish (both Spain- and Latin America-based) journals included

in the Ulrich directory, which increased from 13,279 in 1998 to 18,761 in 2009 (Plaza et al. 2009, p. 48).

Portuguese is also one of the major languages of the world with a number of native speakers oscillating between 205 and 230 million. Like the Spanish Latindex international database, the Portuguese-medium international database SciELO (Scientific Electronic Library Online) clearly shows that scientific research output in the form of publications is visible on the international stage (Pabón and da Costa 2006). Portuguese as a vehicular language in science displays a significant scientific productivity rate. Undoubtedly, free online access through SciELO has contributed to the increasing visibility of Portuguese-medium science dissemination. Linguistic policies in scientific dissemination are of course promoted by governments and research institutions. As a case in point, the development of SciELO Bolivia was jointly coordinated by the Bolivian Vice Ministry of Science and Technology and San Andres University. SciELO Brazil, the major compiler of Brazilian Portuguese journals, was the result of a research project conducted by the Fundação de Amparo à Pesquisa (São Paulo), and has the support of the Conselho Nacional de Desenvolvimento Científico e Tecnológico.

French and German are international minority languages of science with similar socio-economic and historical roots. Both were leading scientific lingua francas in the seventeenth and eighteenth centuries. French was strongly supported by the French Academy of Sciences in the nineteenth and early twentieth centuries, particularly in fields such as medicine (cf. Benfield and Howard 2001, p. 243). Although its geolinguistic status is now considerably lower than that of scientific Spanish, for instance, it is strongly supported by government policies for intranational scientific exchange in particular but also for transnational exchange (cf. Martin and Chabolle 2010 for further discussion). Today France has five academies of science forming the Institut de France, which plays a key role in the dissemination of French-medium scientific research. Alongside institutional support, digital technologies and free online gateways such as Persée, Portal des Revues Scientifiques, a major repository of French-medium scientific publications, help to sustain the role of French in scientific communication. With clear postcolonial associations, French is a leading vehicular language of science covering the geographical locations of France, Switzerland, Luxembourg and the region of Quebec in Canada. As for German, while current governmental policies encourage for reasons of competitiveness national-based research through intranational communication, digital libraries and online catalogues play a key role in promoting German-medium publications internationally. The German Education Index, under the auspices of the German Institute for International Educational Research and the German Research Association (DFG), provides free access to scholarly repositories. Arachne is supported by the University of Cologne and disseminates science in German in the disciplinary domain of the Humanities and Arts.

From the above, it is not difficult to ascertain the way ICTs and digital technologies are contributing to the development of repositories of scientific knowledge and gateways for scientific dissemination, fostering and promoting the construction of core and peripheral geolinguistic spaces in the contemporary landscape. What is difficult to predict is whether the status and relevance of concurrent scientific languages operating alongside scientific ELF will be maintained in the long run or whether they will diminish as a result of the predominance of scientific ELF. If we want to preserve the rich plurilingual and multicultural diversity of scientific communication in the age of globalization '[a]s balance is therefore needed, so that these languages can be preserved and strengthened, while at the same time English is employed as the world's lingua franca for such universal concerns as science and technology' (Sano 2002, p. 49). Core vs alternative geolinguistic spaces underpin problematic issues of competition in knowledge-intensive economies and thus entail something different from Giddens's conception of globalization as interrelatedness and cooperation. Indeed, the politics of languages and the way they impact the conversations of science are, and will continue to be, the subject of intense linguistic debate.

A Note on EAP Pedagogy

From what has been previously discussed, it appears that scientific discourse truly reflects 'the sociality of discourse' at textual, discoursal and rhetorical levels. This conception of discourse endorses the postulates of the new Rhetoric School on the rhetoric and ideology of genres, and is consistent with the view that '[h]owever much an utterance or piece of writing may feel like purely individual expression, discourse is also social, situated and motivated, constructed, constrained and sanctioned' (Coe et al. 2002, p. 10). The view of scientific discourse as process-and-product shaped and as being constrained by the ethos of science, individual styles, community practices and procedures, cultural identities, linguistic policies and institutional decisions suggests that socio-constructionist EAP instruction is necessary.

Offering an integrated view of the above-mentioned variegated constraints would certainly 'encourage student meta-awareness of the social nature of genres' (Johns and Swales 2002, p. 25). Exposure to the most recurring genre types of scientific dissemination and exchange involves providing instances of real language usage. These textual instances embed specific communicative purposes, audiences and established practices within a given sub-disciplinary community. In addition, text exemplars instantiate culture-specific traits in the discourse produced by scholars from non-Anglophone contexts along with the textual constraints imposed by the social and institutional dynamic. Awareness of these aspects should become an essential component of the comprehensive instructional input leading to advanced academic literacies.

As explained in Chapter 3, Bhatia's (2002b) top-down analytical perspective brings to the fore the way genre and register constrain the semantic and lexico-grammatical layers of the discourse. Bhatia's bottom-up approach advocates EAP instruction focused on lexicogrammatical structures and the meta-functional components of scientific genres. In addition, instruction should raise awareness of the context of situation (register) and the social context (genre). In other words, becoming a successful communicator of science necessarily requires knowledge of how to interact in a community of action and an understanding of the communicative purposes of the texts, the participants and the social and situational constraints of the interaction. Mastery of scientific discourse as a product would involve an understanding of its informative and persuasive goals and the ability to respond appropriately to the specificity of its audience and its audience expectations as well as to the standardized textual conventions established for effective communication. Mastering scientific discourse requires awareness of the process through which new knowledge becomes text, how such knowledge matures as it goes through various community procedures and practices, how written/spoken genres interact and nurture from others and how language brokers of various types and journal peer review systems operate in the publishing process. In view of the above, several types of instructional focus can be utilized in the EAP classroom (Figure 7.1). Depending on the specific learners' needs, the instructor may decide to address the four types holistically or to put emphasis on the particular area(s) in which learners are weak(er).

A tailor-made course (i.e. one described in the terms proposed by Munby 1978 and Hutchinson and Waters 1987) may target, for instance, scientists with a low proficiency level of English and with no (or little) experience in scientific discourse. This course should draw particular attention to language structures, without disregarding register requirements and social/situational

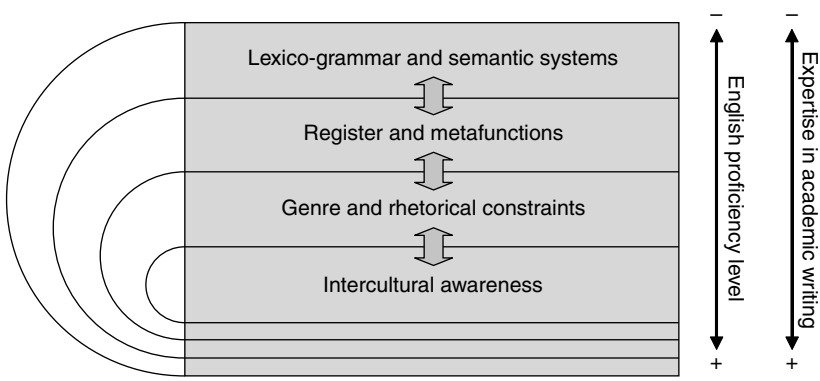

Figure 7.1 Proposed types of instructional focus for an EAP learner-centred course design

constraints of the genre. A tailor-made course for English-proficient scholars and with no (or little) experience in scientific discourse texts and practices will devote greater time to the register features of field, tenor and mode on the one hand, and to socially situated aspects of the genre on the other hand. A course targeted at scholars with high levels of English proficiency and expertise in discourse practices would approach and revise the four types of instructional focus in an integrated manner holistically. Only a holistic view of these types of instruction will provide solid foundations for understanding the complex nature of scientific discourse as a social textual product and process.

Competence in linguistic systems guarantees accurate and meaningful communication in the target language. Awareness-raising analytical tasks along with practice of the appropriate use of lexicogrammar will help scientists communicate contents in a comprehensible manner and eventually guarantee the credible reporting of scientific facts based on evidence even if these are of a provisional nature. In addition, learning how to write up disciplinary research may profit from the appropriate use of the specialized vocabulary of a scholar's sub-disciplinary field, as this type of vocabulary helps writers construct the semantic scaffolding of discourse (cf. also Nation 2001, Woodward-Kron 2008). Intrinsically related to linguistic competence, competence in the metafunctions of language involves an understanding of how the ideational, interpersonal and textual aspects of language interact in language use. Instruction based on awareness-raising tasks is suitable for showing learners how these aspects are reflected in the writers/speakers' use of transitivity, mood and theme respectively.

Echoing the corpus and ethnographic findings reported in previous chapters of this volume, establishing initial contact with the audience, displaying varying degrees of authorial commitment or detachment towards propositional meanings and projecting varying stances are essential aspects for mastering scientific discourse. Practice using linguistic resources such as transitivity, the English modality system and thematic development of texts foregrounds the interrelation between the lexicogrammar and the semantic strata of scientific genres.

A further instructional target is that of boosting and hedging the discourse conveniently, particularly if we recall the scholars' recurrent observations on the difficulty of appropriately explaining the research motivation, of justifying the interestingness of the topic; in other words, of selling the research first to science gate-keepers (i.e. editorial boards and scientific committees) and then to the wider audience of experts in the discipline. Explicit instruction on modality and rules of pragmatic politeness may show novice scholars how to express their stance and critically assess disciplinary knowledge while maintaining an appropriate balance between the assertive projection of an intellectual identity and the exigencies of scientific knowledge and institutional gate-keeping – by this means establishing connections with the social systems constraining genres and registers.

Competence in the register variables of field, tenor and mode can be acquired by learning, for instance, how to use metadiscourse resources appropriately (Hyland 1998b, 2005, Ädel 2006, 2008, Ädel and Mauranen 2010). Acquaintance with text-oriented discourse functions of language (e.g. introducing the topic of the text, announcing informational focus, summarizing textual material mentioned previously in the text, introducing examples, indicating that new information is given, explicitly claiming centrality of the information given and concluding) may also guarantee competence in these register variables. Awareness of the discourse functions and communicative intentions of participant-oriented expressions such as anticipating readers' reaction, clarifying or specifying textual material, aligning with readers by presupposing the reader's agreement, and inviting readers to share a similar line of thought likewise aim at the acquisition of register-oriented competence. Explicit EAP instruction on text-reflexivity along the lines described above raises scholars' awareness of ways to achieve successful writer/reader interaction and to guide audiences in order to facilitate informational processing. This type of instruction is apposite in as much as recognizing both the text-oriented and participant-oriented functions of metadiscourse in texts enhances 'cohesive, rather than structural, linking' (Hyland 2007, p. 268) in order to avoid misinterpretations or pragmatic ambiguity.

Drawing upon a social theory of language for EAP pedagogy (e.g. Paltridge et al. 2009), genre-based instructional focus provides insights into how to communicate in institutionally approved ways, how to comply with the rhetorical conventions that pertain to a given textual typology or how to respond effectively to gate-keeping agents and established practices. Genre competence also requires being acquainted with institutional constraints of various types. Awareness of discourse privileges and roles within the disciplinary community may, for instance, help scholars understand how these privileges constrain intertextuality and citation practices. The commodifying forces in universities worldwide and the pressure those forces exert on scholars fosters the understanding of the use of rhetorically forceful linguistic devices such as first person pronouns and self-citations to sell effectively their new knowledge claims. To give another example, awareness of the ethical constraints in scientific research as a society-driven concern cultivates an understanding of the construction of credibility and provisionality through particular lexicogrammar choices such as transitivity and mood.

As to how best to address this genre-based type of instructional focus, Johns and Swales (2002, p. 22) comment on institutional constraints as follows:

> What we can do, across the board, is raise students' awareness, give them a variety of experiences and exposures, encourage their analyses and critique of texts and contexts and motivate them to see the university, like all institutions, as human and constructed, rigid, fluid, hegemonous and negotiable – all at the same time.

Interrelating with competence in lexicogrammar, register and genre is intercultural competence. Intercultural competence is a necessary component in becoming a skilled scientific communicator in the global village. Both in Europe and elsewhere outside the Anglophone circle, the internationalization process universities are currently involved in has made academics become very much aware of the threat that their linguistic and rhetorical weaknesses may represent in the growing exchange of research scholars across universities and research institutions, in the publication of articles in impact journals, in the participation in international conferences and seminars, training and research stays at foreign universities and in other instances of disciplinary knowledge exchange in the research world.

Needless to say, cultural factors play an important role in teaching/learning scientific communication. Awareness of 'cultural collisions in L2 academic writing' (Steinmann 2003) motivated by the differences between the Western notions of academic rhetoric and the L1 rhetoric of non-native English-speaking writers can be developed by corpus-based analysis of both L1 and L2 English (and, if possible, in the scholars' L1 language) and, in particular, by the identification of common and differing communication resources across cultural contexts and languages. Interestingly, critiques of both adaptation to standard academic English and also hybridization with culture-specific linguistic traits, both phenomena described in Chapter 4, raise awareness of 'the complexly interacting small cultures in any educational or other intercultural situation' (Connor 2004, p. 292). Both are issues of the greatest concern for applied linguists, EAP researchers and scholars in the contrastive rhetoric field but also for EAP/ESP teachers, translators, editors and language brokers and, of course, non-native English-speaking academics who need or want to publish their research in English. In this respect, a corpus-based descriptive – rather than prescriptive – approach to scientific English again is germane to sensitize students towards intercultural aspects of contemporary scientific communication.

Aligning with Burrough-Boenisch's (2003, p. 227) identification of 'the nonnative character of the text' in non-Anglophone scholarly contributions, instruction that considers how standard academic English differs stylistically from a scholar's own culture will not only help him/her gain sensitivity towards linguistic differences but also sensitize him/her to the discoursal interplay of the national culture on the one hand and the disciplinary culture on the other hand (cf. Dahl 2004). Simultaneously, it helps a scholar identify his/her particular difficulties when drafting a research paper, a PhD proposal or when preparing an international meeting, to name but a few instances, at both textual and rhetorical levels. Bearing in mind the increasing institutional pressure and pragmatic need to communicate in English in the international sphere, EAP instructors should bring to the fore in the classroom context whether it is more convenient to adapt to the Anglophone norms of academic English as

a way of overcoming linguistic burdens or to retain culture-specific rhetorical traditions. The most prudent stance, in this respect, would be to let scholars decide for themselves according to their specific needs at a given moment and their sensibilities towards national culture.

The holistic instructional focus depicted in Figure 7.1 can be applied to the teaching of the repertoire of academic genres that interact with scientific discourse, both written (laboratory reports, journal abstracts, conference abstracts, PhD dissertations, grant proposals, submission letters to editors, etc.) and spoken (academic presentations, research group meetings, paper presentations and poster presentations, among others). An integrated view of genre colonies is thus most fruitful in order to grasp the nature of scientific discourse. Responding to the global sociolinguistic challenges of the twenty-first century that derive from the geopolitics and economic interests impacting languages and cultures in the global village, the concluding chapter seeks to re-conceptualize science and the rhetoric of globalization.

Chapter 8

Re-Defining the Rhetoric of Science

The Rhetoric of Contemporary Science: A Response to Global Challenges

This volume has reflected on the dynamics of the processes of scientific knowledge production and reception in contemporary times with a view to situating the discussion within a broader, multidisciplinary, framework than has been the case hitherto. This framework has sought to provide an integrated perspective of the array of contextual aspects constraining the text-linguistic scaffolding of scientific discourse. In addition, the framework gives further relevance to Latour and Woolgar's (1986, p. 13) broader claim that 'the social world cannot exist on one side and the scientific world on the other because the scientific realm is merely the end result of many other operations that are in the social realm'.

Scientific enquiry, textually reified in scientific discourse, can be understood as a representation of a global response to society's needs. Contemporary scientific discourse is, as it always has been, a manifestation of scientists' search for understanding of reality and its multifaceted principles, values and ideologies. This search is rooted in different epistemologies – for example, those of the physical sciences, the biomedical sciences, the social sciences and the humanities – and grounded in different multidisciplinary theoretical, empirical and applied approaches. At present, scientific enquiry also brings innovation to the forefront, a driving force able to adapt the traditional knowledge production model to a transferable, practical model closer to society's needs and to the particular demands of today's economies, industries and markets.

The main difference between science in the postmodern age and that of previous times probably resides in the way technologies have revolutionized social relations. In particular, information access and information exchange through the internet and other forms of electronic communication have transformed the processes of production and reception of scientific discourse. In its various domains of action – social, economic and political – globalization in the digital age very much relies on communication networks. It goes without saying, for instance, that in a networked scientific communication context, large electronic databases and directories of open access archives and

journals become all-encompassing repositories of bibliographical records and the latest research outputs (European Commission 2006, cf. also Kaufman-Wills Group 2006 on the scope of open access journals). These newly coined 'cyber-infrastructures' or 'higher performance networks' (Herr et al. 2006, p. 161) close the space and time gaps that lack of access to those resources may create. Scarce or very scarce discontinuity across research networks now offers a constructive conceptualization of globalization, one ruled by common interests for the advancement of knowledge and the welfare of society. In creating continuity, communication networks sustain the global economy and in turn are expected to bring to the fore challenges, employability, applicability and sustainability and show potential for an enhanced use of knowledge production, infrastructures and human resources for societal well-being. From this perspective, electronic facilities can be conceived as key milestones for the dissemination and exchange of contemporary science.

If we consider the high traffic of people globally, it goes without saying that in and across current scientific research networking activities, the predominant geopolitical and geolinguistic status of scientific English will probably endure at least in the near future. The need for a common language for mutual understanding, along with local and national pressures of internationalization, increased transnational competition and global economic and market forces generally favourable to English, is placing scientific English at the forefront of contemporary scientific production and dissemination. With universities playing the role of major knowledge manufacturers, growing transnational cooperation and research networking across both Anglophone and non-Anglophone academics are guaranteed if a common language is used. Scientific English, an indisputable player in the English linguistic imperialism debate discussed earlier, makes possible the interaction among peer scientists, as well as the interaction between scientists (experts in a discipline) and students (novices and junior scientists in a discipline) in higher education and research contexts. Further, it favours the interaction between scientists and the institutions and/or the professionals that demand transferability of scientists' research activities.

In addition, the rhetoric of contemporary scientific discourse, as any other manifestation of global cultural trends, also shows enhanced sensitivity towards cross-cultural differences in transnational, plurilingual research communication. In the EAP research arena, this sensitivity can be gauged by several indicators. By way of illustration, the impact of language and culture issues is currently a subject to be debated in journals like the *Journal of English for Academic Purposes*, *English for Specific Purposes*, *Journal of Second Language Writing*, *International Journal of Applied Linguistics*, *World Englishes* or *Applied Linguistics*, to name but a leading few, which contain papers focusing on language issues in academic and research contexts.

An interesting view of the socio-cultural phenomenon of multilingualism that can further shed light on contemporary dynamic processes of scientific

knowledge production is that offered by Bloomaert et al. (2005, p. 197). These authors introduce the categories of space and scale to analyse this phenomenon by explaining that '[s]pace and scale offer a connection between macro-conditions and micro-processes, which allows us to focus on multilingualism as a matter of conditioned resources as well as interactionally "framed" practices'. In the domain of scientific communication, English operates at a macro-scale and occupies a world spatial dimension. For this reason the use of English in plurilingual scientific settings inevitably contests the widespread monolingual assumptions informing scientific discourse practices. In doing so it simultaneously foregrounds those micro-processes of scientific knowledge production that take place at local, national and transnational levels – in short, those micro-processes in which plurilingual scientists worldwide carry out their everyday research activities.

Scientific plurlingualism and, more specifically, the 'interactionally "framed" practices' referred to by Bloomaert et al. appear to echo Connor's (2008, p. 299) conception of scientific discourse as an 'intercultural encounter where writers are interacting in the production and comprehension of texts', hence foregrounding the intricate relation between discourse, language and cultural context. Nickerson (2004, p. 107) makes a further point in this regard and argues that speakers/writers, in addition to using the socio-cultural and discourse strategies in English as they do in their own culture, could also 'use – or be in the process of developing – their own linguistic strategies in English that may be related to those of their first language'. Along very similar lines Bondi (2004, p. 58) conceives English lingua franca as a hybrid language 'characterized by different underlying traditions or worldviews'. Certainly, the number of non-native English-speaking authors publishing internationally in the academic world is on the ascent, and the 'hybrid third' (Mauranen 2001, p. 54), that is, a discourse in which Anglophone normative rules merge with culture-specific linguistic features instantiating a rich variety of non-normative writing styles, is also on the increase. This hybrid third was precisely the case of the L2 English texts analysed in Chapter 4 of this volume. Indeed, language and cultures will continue to be key players in the macro-scale processes of scientific knowledge production. The following section addresses the micro-scale processes of scientific knowledge production and dissemination.

Textualization, Organization and Contextualization of Scientific Knowledge

In explicating the tenets of critical discourse analysis, Fairclough (2006, pp. 10–11) points out a number of text-external factors influencing the actual meaning-making configurations – and hence text-internal features – of every discourse construction:

> [. . .] meanings are made through the interplay between [producers and receivers]: we must take account of the institutional position, interests, values, intentions, desires of producers; the relations between elements at different levels in text; and the institutional positions, knowledge, purposes, values, etc.

Similarly, the actual meaning-making configurations of scientific discourse and, more specifically, of the scientific genre sets and networks have been shown to depend on a number of text-external factors that determine the three main levels of textual analysis/scaffolding, namely, the linguistic, the discoursal and the rhetorical. The overall configuration of meaning-making in scientific discourse practices is briefly summarized in Figure 8.1. This figure illustrates an understanding of scientific genres as 'frames for social action' (Bazerman 1997, p. 19) in which the production, exchange and dissemination of scientific knowledge take place. This figure is of particular interest in order to understand the different asymmetries of discourse roles, the subsequent shades of rhetorical forcefulness across scientific written/spoken genres and the incipient processes of genre mixing and appropriation on the grounds of the following interactional settings: senior-novice communication, peer-to-peer communication and institutional communication.

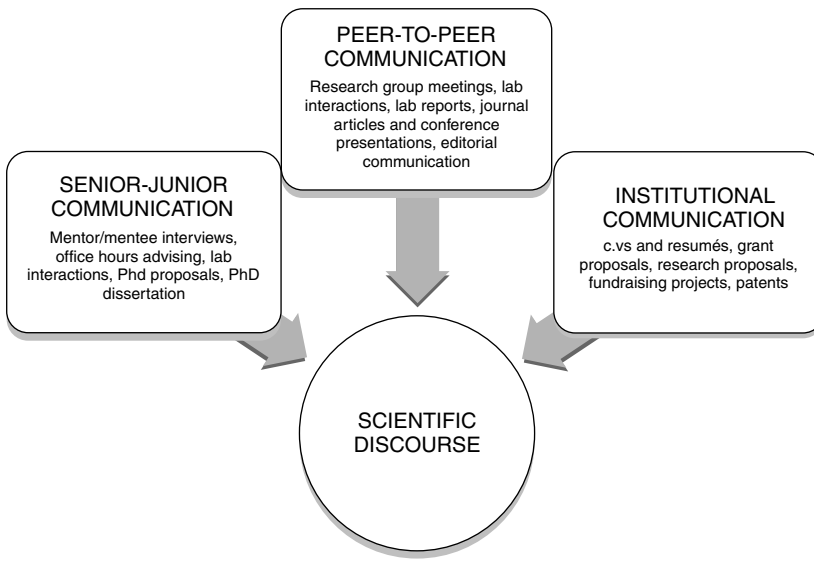

Figure 8.1 Meaning-making configurations for the construction of scientific discourse

In today's global village, the conception of these concurrent meaning-making configurations is even more complex if one bears in mind that scientific discourse is inescapably molded by local, national and transnational spatial constraints. The first meaning-making configuration, which involves communication between senior and novice/junior scientists, is mainly pedagogically oriented and primarily instructional in nature as it involves processes of both disciplinary and academic enculturation. Since discourse is produced and received in local settings, the rhetoric underpinning the discoursal scaffolding of this particular meaning-making configuration can be roughly defined as one constructing convivial relations between interactants and one which keeps discursive privileges to a minimum. The second meaning-making configuration concerns peer-to-peer communication, takes place at local, national and transnational levels. At a local level, this configuration involves informal knowledge exchange in a given research site – be it a meeting room, a lab or an office. In national and, above all, transnational scenarios, knowledge exchange generally tends to be more constrained by established structural, genre and stylistic conventions in the written than in the spoken mode of interaction. The uniformity of conventions mainly targets at facilitating the construction of texts and then guaranteeing eventual communicative effectiveness. The third meaning-making configuration, framed within the boundaries of institutional communication, is clearly on the increase due to the transferability and commodifying trends explained throughout this volume. Compared to the other meaning-making configurations, institutional communication renders a type of discourse which is not only constrained in terms of structural organization but also shaped by established institutional roles, privileged statuses and gate-keeping practices. Configured this way, communication often involves scientists' efforts in climbing up the academic ladder, securing a position or gaining prestige and recognition at various levels. Accordingly, the rhetoric underpinning the genres framed within this configuration is generally more forceful, with persuasion and promotion purposes sustaining the construction of the discourse at textual level. As illustrated by the contrastive analysis of Chapter 4 this volume, this rhetoric involves 'appropriations of generic resources across conventional rhetorical boundaries' resulting in a subtle process of 'colonization of academic, professional and institutional genres' (Bhatia 2004, p. 90).

As seen in Figure 8.2, variation along the informational/promotional cline underpinning each of these meaning-making configurations in the construction of scientific discourse places senior-novice/junior communication at the informational-end of the scale and institutional communication at the promotional-end of the scale, situating peer-to-peer communication at a balanced standpoint in terms of informational and promotional communicative goals.

Drawing on Askehave and Swales's (2001) approach to repurposing genres, it can be argued at this point that scientific discourse is first and foremost targeted at knowledge exchange and knowledge dissemination in its different

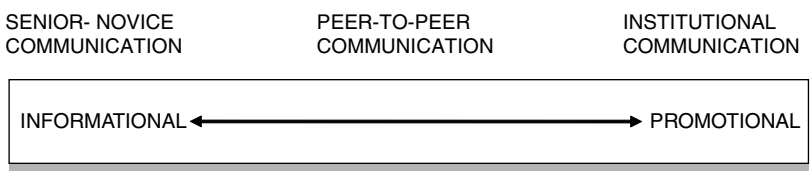

Figure 8.2 The informational/promotional cline of science rhetoric

interactional scenarios. Its formal features are shaped by clear-cut conventions for standardized structural organization, as well as for text-linguistic rendering and overall stylistic expression. These features allow sufficient flexibility to encompass major variations in terms of register (written vs spoken), discipline-specific orientation, idiolectal preferences and, last but not least, cross-cultural and cross-linguistic variation. Coexisting with its primarily informational goal, contemporary scientific discourse proves to be a contrived exercise in linguistic acrobatics which relies on a range of evaluative and (self)-promotion elements targeted at finding a niche and becoming visible in the research community. Persuading and interacting with addressees are typical writers/speakers' means of seeking acceptability of new knowledge claims by the members of the community of practice.

Having clarified the concurrent meaning-making configurations pertaining to the construction of scientific discourse, two further issues need to be borne in mind. First, it is worth noting that the use of online spoken and/or written communication thanks to the latest ICT developments cuts across the three concurrent meaning-making configurations of scientific communication and their distinctive rhetorical nature. The rhetorical features of online communication for scientific dissemination purposes are evolving in nature and display a fair amount of flexibility and adaptability to users, intentions and contexts. This may explain why this type of communication, in spite of being an indispensable tool in every scientific and research site, is somewhat under-researched compared to the attention given to the prominent scientific genres such as those included, for instance, in Figure 8.1. Second, it is also important to note, as also addressed previously in this volume, that an all-inclusive conception of contemporary scientific discourse should necessarily bring to the fore the so-called speech/writing continuum. Sets of written and spoken genres are created in and across the three different meaning-making configurations explained above. In Swales's words (2004, p. 2) genres are no longer to be seen 'as single – and perhaps separable – communicative resources, but as forming complex networks of various kinds in which switching modes from speech to writing (and vice versa) can – and often does – play a natural and significant part'. Conceiving genres as discrete, unrelated textual constructs would fall short of acknowledging the obvious speech-writing continuum underpinning the factual generation, production and reception of scientific knowledge production and dissemination.

Text-Internal and Text-External Features of Scientific Rhetoric

As explained earlier, Bhatia (2004, p. 123) refers to both 'text-internal' features (i.e. lexicogrammar, discourse and rhetorical organization) and 'text-external' aspects of texts (i.e. the procedures and practices for the construction and interpretation of the texts by the members of the community of practice). If we consider the text-internal features that recur across the range of scientific genres taking place in senior-novice/junior communication, these typically feature academic spoken lexicogrammar. This would be the case, for instance of mentor/mentee interactions and academic advising/counselling. Cognitive patterning, discoursal organization and rhetoric and style conventions tend to be fairly standardized in the written genres (e.g. PhD proposals and dissertations), more so than in the spoken ones (e.g. lectures, conference paper and poster presentations). The latter are instances of extemporaneous speech; the conventions are looser, more individualized and dependent on numerous other text-external constraints.

The text-internal features of genres reflected in peer-to-peer communication involve a greater level of textual standardization, again, in the written mode. Displaying marked form-function correlations, the recurring lexicogrammar and its discourse and rhetorical functions target at effective production and reception of texts. Across genres, there is shared agreement of phraseological embedding of ideas and established conventions defining degrees of authorial stance in the construction of addressor–addressee relationships. In a broad sense, these formal regularities maximize the information transfer and very much adhere to Kuhn's (1962, p. 42) content-driven conception of scientific discourse:

> The scientist must, for example, be concerned to understand the world and to extend the precision and scope with which it has been ordered. That commitment must, in turn, lead him to scrutinize, either for himself or through colleagues, some aspect of nature in great empirical detail. And, if that scrutiny displays pockets of apparent disorder, then these must challenge him to a new refinement of his observational techniques or to a further articulation of his theories.

As discussed later, text-embedding and intertextual framing of new scientific knowledge recur at a textual level and perform rhetorical functions in the construction and interpretation of genres such as research articles, conference papers and, generally speaking, all those genres primarily constrained by text-external factors such as, for instance, the gate-keeping practices established by the scientific community. As the process of scientific knowledge dissemination broadens in scope and moves from the national into the international

milieu, the communicative purpose of scientific discourse can be more narrowly defined as follows: '[. . .] to persuasively argue to a particular community of readers that they should accept the interpretation of new or previously accepted information as sound enough to function as the basis for the inspection or creation of yet additional new knowledge' (Benson 1998, p. 211). In addition to using rhetorical strategies for persuasion purposes, other scholars have further noted that '[r]hetoric is necessary in scientific communication as it is ultimately subject to the provisional nature of science itself' and have attributed the use of rhetorical strategies as a textual strategy to counterbalance the fact that in the domain of science '[m]ost claims are not self-evident; they must be supported with arguments that connect the data, whatever they are, with the interpretation and conclusion being proposed' (Reeves 2005, p. 96). This evokes similar views retrieved from the ethnographic study of Chapter 5, and more precisely, one native English-speaking scholar's conception of the process of creating scientific discourse as an 'art form':

> My own philosophy is that science is an art form of the 21st century, and so a research article is really art, and it has a special format, just like any kind of art form and, basically, a science paper has to tell the truth, every line has to actually be true. But the story is more than a fact. Basically, you weave a story that makes sense but with everything being accurate, you can't change the details so that the story sounds better. You have to tell a story and it has to be really good; otherwise it doesn't make sense. (UM immunologist, 16 July 2010)

As scientific communication moves closer to the institutional arena it becomes more promotional and not simply knowledge-guided, as it usually plays on the premises of competition, promotion and excellence, all of them text-external factors established at local, national and international levels. As a result, scientific discourse gains in persuasiveness which, in a sense, corroborates early scholarly claims noting that 'the writing-up of results was more of an after-the-fact reconstruction to make one's results seem attractive, important and true to the consumers of knowledge' (Knorr-Cetina 1981, p. 78). At present, Knorr-Cetina's comment appears to be even more relevant than three decades ago given current text-external constraints. Research transferability/applicability and the degree of innovation represent a major concern among governments and economic systems worldwide.

In view of the above, the text-internal indicators of the repertoire of scientific genres should be considered, as systemic functional grammarians postulate, from 'the perspective of social context (science and institution)' (Halliday and Martin 1993, p. 25). The systemic functional perspective allows close examination of text-external factors operating in the immediate communicative context with which the different genres are associated,

the particular communicative purposes of each genre and the interactive context in which those genres are produced and received. As every other type of discourse, scientific discourse successfully responds to both academic and non-academic (social, cultural, economic, local, intranational, transnational) demands with relative ease. Concern with social practice thus confirms the need for a 'context-driven' procedure for genre analysis, which takes into account 'a number of factors other than textual' (Askehave and Swales 2001, p. 81).

In sum, both text-internal and text-external features shaping and constraining scientific rhetoric and discourse constitute what Bhatia (2004, p. 88) defines as 'generic integrity', a 'socially constructed typical constellation of form-function correlations representing a specific professional, academic, or institutional communicative construct realizing a specific communicative purpose of the genre in question'. Essentially, all these textual features are not static, but rather dynamic. As a particular type for language usage, scientific discourse is therefore subject to shifting communicative purposes, participant roles and value-laden conceptions of settings at a given historical time and social state of affairs.

Generic Integrity and Genre Mixing in Scientific Rhetoric

The generic integrity of the genre sets involved in contemporary scientific discourse, shaped at a text-internal level by the text-external features, can thus be viewed as an all-encompassing construct that facilitates minute examination of the front and the back stages of scientific knowledge production.

Regarding the front stage, the rhetorical organization conventions across the repertoire of scientific genres allow an accurate picture of the way knowledge is created and textualized and then disseminated, exchanged and interpreted for the advancement of science. The front stage brings us closer to the complexities of the nature of disciplinary knowledge and its growing need for increasing specialization as well as interdisciplinary and multidisciplinary dialogue. The front stage also invites scrutiny of the use of English as the lingua franca for scientific and research dissemination and the way this language embraces rich multicultural variability within the traditional L1 English normative standards established for scientific communication. Further, it raises concerns about both the discursive and non-discursive privileges of scholars in what scholars have called 'core vs peripheral' participation within the dominant scientific order.

Complementing the perspectives offered by the front stage, the back stage of scientific discourse provides a concise ethnographic mapping of discourse practices and community procedures. It reveals the ongoing dialogue across disciplinary practitioners, specialists and experts in local, national

and transnational communication. The back stage also unveils the contradictory overlap between strictly disciplinary interests, both science-oriented and society-oriented, as well as large-scale non-disciplinary interests such as the construction of knowledge-intensive economies and the development of research excellence areas that in turn strengthen already consolidated geopolitical centres.

The view of scientific production and reception as 'symbolic capital' for the welfare of knowledge-intensive economies is reflected in the textualization of promotional features across the repertoire of scientific genres. Unquestionably, such promotional nature is becoming most conspicuous in the academic genre par excellence, the research article genre, as illustrated and discussed in earlier chapters. But in modern academia, the need and/or wish for promotion, recognition and prestige appears to go beyond mere individual endeavours. Though partially contradicting the scholars' perceptions of scientific research as a means of satisfying personal curiosity for exploring scientific facts and a personal contribution to the development of scientific knowledge for society's wellness, the conception of scientific discourse as symbolic capital instantiates how globalization places 'a premium on nonmaterial resources that move beyond economic wealth' (Whitley 2000, p. 25, cf. also Putnam 2009). The symbolic capital that scientific discourse production and reception represents in present times arises from the demands for accountability established by intersecting activity systems, namely, society, governments and institutions. As Fairclough (2003, p.78) concisely puts it, textual production and reception are confined by the 'marketization of discursive practices'. Like layman discourses, scientific discourse is subject to the decisions and demands of global political and institutional agendas, existing governance structures and economic growth prospects.

In approaching the current dynamics of today's scientific communication, genre theory brings together the processes, products and practices underlying the production, dissemination and reception of new scientific knowledge. The scientific arena is now witnessing an increasing proliferation of new genres emerging to meet new social communicative demands. The ample genre sets that are shared, produced and interpreted by the members of the scientific community are learned and acquired through disciplinary practices and discourse procedures for interaction in local, national and transnational communication. Major genres such as the research article, the conference abstract, academic lectures, dissertation defenses or grant proposals form genre networks and genre chains as they interrelate and are often time-sequenced. A clear example is a conference abstract, which later becomes a conference presentation and may eventually turn into a journal article or a book chapter. In addition, minor or occluded genres such as research group meetings, letters to editors or acknowledgements, to name a few, constellate around major genres forming genre colonies. Genre chains yield evidence of the speech-writing

continuum discussed in previous chapters, with spoken genres leading to the construction of written ones or vice versa. The generic integrity underpinning these genre sets and chains evolves out of practice, yet it adapts to and undergoes ongoing processes of transformation to comply with text-external agendas.

Previously, we referred to major changes in the everyday activities, discoursal practices and procedures that scientists in the different disciplines engage in and how these activities are reflected in their textual products. Yet the observations and discussions of the present volume appear to indicate that collaborative and individual disciplinary community routines should be seen holistically for a better understanding of the rhetorical nature of scientific discourse on the one hand and, on the other hand, of the different ways discourse materializes across 'textographies of discursive practices' (Swales 1998) and 'critical sites of engagement' (Scollon 2001). Both the textualization of lexicogrammatical resources and the contextualization of the textual products in the light of the communicative practices of each disciplinary community are crucial aspects for further linguistic and ethnographic enquiry, as they intrinsically relate discourse practices to the research sites where the texts themselves are produced and received by the members of the community. It is precisely in those sites where new knowledge begets text, the actual text materializes, merges and interrelates with other genres, conventions and previous texts. Analyses that integrate communicative goals, textual products, discursive practices and disciplinary memberships should prompt future discussion on more extensive definitions of the linguistic resources and rhetorical goals of contemporary scientific discourse.

The genre perspective offers a comprehensive view of science rhetoric shaped by socio-cognitive constraints targeted at maximizing the cognitive processing of information. It allows detailed introspection into the range of rhetorical strategies for composing texts and in doing so it brings to the fore the versatility of linguistic forms and the variety of rhetorical strategies that scientists can use to inform, promote and/or persuade about issues of science. As illustrated previously with the case of research article writing, the variegated heteroglossic engagement discourse modes of expression in written and spoken communication are built upon the intermingling of propositional, semantic and pragmatic meanings conveyed in the discourse. In other words, the construction of dialogic spaces in written/spoken genres becomes a conscious decision-making process on the part of the addresser that involves constructing rhetorically forceful texts so as to tune them to the expectations and assumptions with which such texts are going to be received and interpreted. As argued by Askehave and Swales (2001), determining the particular communicative purposes of a given genre is always more complex than originally envisaged.

The informational and cognitive scaffoldings of scientific discourse are co-constructed along with the use of rhetorical features that bring to the

surface the marketization of discourse through genre mixing and genre embedding processes. Genre mixing processes are observable in the growing use of self-promotional features in scientific genres such as research articles, grant proposal, book blurbs, bionotes, tenure and promotion letters or introductory speeches, chairing sessions, to name but a few examples in academia. These processes lend credence to the assertion that 'rhetorical considerations govern grammatical choice' (Dudley-Evans 2000, p. 4). Instantiating the text-context interrelation, scientific discourse appropriates promotional features from other discourses so as to become responsive to the pressures of competition, commodification and internationalization of scientific activity in the local, national and international spheres.

Similar rhetorical considerations can also be observed in genre embedding processes, namely, processes that take place when a given genre format is imported into a new genre. A clearly emerging example of embedded generic formats can be found in written digital genres combining textual and multimodal elements such as personal academic websites or electronic publications. In spoken genres, inclusion of anecdotes or personal accounts in academic talks for establishing analogies and affinities in a domain-specific disciplinary field or for grabbing the audience's attention may break the expected conventionalized genre format. Identification of genre mixing and embedding processes renders an understanding of scientific genres as 'inherently dynamic rhetorical structures that can be manipulated according to conditions of use' (Bhatia 1993, p. 22; Johns 2002). Both genre mixing and embedding can then be regarded as generic processes of adaptation to the new communicative demands of changing social times and to the text-external agendas mentioned above.

At this juncture, it can be claimed that the rhetorical construction of scientific discourse at the turn of the first decade of the twenty-first century undeniably reflects positions of influence, power and status in terms of accessibility of technological, human and economic resources, as well as in terms of discursive roles and privileges and differences in access to power. If we triangulate the issues of science, language and culture, and globalization discussed previously in this volume and regard every genre type as 'a nexus between an individual's actions and a socially defined context' (Devitt 2004, p. 31), we can conclude that the generic integrity of scientific genres lays bare a number of major intertwining issues. It reflects an intellectual dialogue and debate on issues of curiosity in understanding the world outside. It allows the reconstruction of discourse community assumptions, normative approaches and dominant discoursal paradigms. Further, by drawing our attention to the dialectics of meaning-making, meaning-exchange and meaning-reception, it provides gained understanding of the way the globalizing trends unavoidably coexist with ongoing glocalization and localization processes in the world's scientific communication.

Substantiating Metaphors of Genre

A characterization of the genre repertoire that scientists bring into play today requires further discussion on the potential uses of genres within a socially defined context. Such uses have already been described by Swales (2004, p. 149) in terms of analogies or metaphors of genres, and also addressed, though briefly, in Chapter 3 of this volume. Swales (2009, p. 149) expands on Fishelov's (1993) initial set of analogies to understand literary genres and provides an updated view of genres as follows:

Frames of Social Action	→ Guiding Principles
Language Standards	→ Conventional Expectations
Biological Species	→ Complex Historicities
Families and Prototypes	→ Variable Links to the Centre
Institutions	→ Shaping Contexts; Roles
Speech Acts	→ Directed Discourses

As discussed below, these metaphors appear to remain valid yet the characterization of genres in contemporary scientific communication directs even greater attention to the idiosyncratic sociality of discourse in relation to the phenomenon of globalization. Scientific discourse can be seen as a text-linguistic scaffolding upon which 'conversations of the discipline' (Bazerman 1988) are constructed. Because communication is always socially mediated, the construction of 'disciplinary voices', 'disciplinary identities' or 'community identities' (Medway 2002, Dressen-Hammouda 2008, Matsuda and Tardy 2008) is necessarily based upon general guiding principles. Knowledge or lack of knowledge of these guiding principles, in turn, is what distinguishes the insiders from the outsiders of a given community of disciplinary practice and the scientific community in general.

Conversations within and across the disciplines bring to the fore the fact that it is in the writing and speaking of science that scientists generate new knowledge. Only by constructing 'scientific discourse' can science be textualized and disseminated and, vice versa, only dialogism in science can make science evolve. Therefore, ways of producing and interpreting texts within and across disciplinary communities need to be ruled by established language standards. These commonly agreed norms, as described and illustrated earlier in this volume, aim at supporting the construction of texts and maximizing the cognitive understanding of those texts by the members belonging to the different communities of disciplinary practice. As also claimed throughout this volume, scientific discourse does not only mean end-products but also social interaction through processes and disciplinary practices (Parker 2002).

Discourse practices and community procedures for engaging the 'manufacturers' of knowledge in interactive processes appear to bring about increasing

genrefication of scientific communication. New 'biological species' emerge and evolve with the new signs of the social times. Of note, as argued earlier, is the advancement of new technologies playing a major role in the creation of new forms of electronic asynchronous and synchronous types of communication. ICTs are also contributing to the development of multidimensional electronic texts with hypertextual links that defy the conventional linearity of the reading process and provide readers with much wider options to access and retrieve new knowledge. Multimodality in written genres such as the recently launched Article of the Future (which includes author's videos, interactive graphs and hypertextual links among other features) or multimodal elements such as powerpoint presentations and videos accompanying conference presentations yield new avenues for communicating science successfully.

The families and prototypes analogy brings to the fore the formulation of scientific discourse as a rich diversity of written and spoken genres forming networks, colonies and sets. The repertoire of genre options provides scientists with an ample range of alternatives to achieve their intended communicative goals in the different situational contexts in which science is generated, exchanged and disseminated. Once genres are comprehensively defined through systematic use within a community of practice they become prototypical, standardized models. Though exemplary, generic options are evolutionary in nature. They respond to new communicative demands and take advantage of the new technologies and incorporate multimedia elements, as discussed earlier.

Contemporary scientific discourse also instantiates the idea of genres as conventional textual forms embedded and constrained by institutional contexts, established discourse roles and discursive privileges. In debating the rhetoric and ideology of genres, Coe et al. (2002, p. 2) pointed out that '[h]owever much an utterance or piece of writing may feel like purely individual expression, discourse is also social, situated and motivated, constructed, constrained and sanctioned'. As every other discourse, the discourse of science is neither value-free nor neutral. The construction of genres is grounded in the rhetorical exigencies set by institutional gate-keepers of science. In turn, the textual scaffolding this construction is based upon reflects the ideologies underpinning departments, universities, national governments and global economies.

Finally, scientific genres epitomize a range of speech acts whose propositional meaning may further convey illocutionary force (e.g. asserting, inquiring, evaluating, questioning, critiquing) or perlocutionary force (e.g. agreeing/disagreeing, persuading and convincing) in various different ways. Evoking Austin's (1962) most influential work, *How to Do Things with Words*, the rhetoric of contemporary science gives evidence of the range of discoursal and rhetorical choices that writers/speakers use to convey stance, engagement, evaluation, appraisal and other pragmatic effects (Hyland 2005). Linguistic resources of intersubjective positioning and diverse heteroglossic discourse

modes of engagement with audiences substantiate the intentionality and dialogism inherent in contemporary scientific communication.

A final note should be made at this point on these generalizations on genres. As argued by Fishelov (1993, p. 159), not all metaphors apply equally to all genres and hence there is a need for a pluralistic view in examining generic typologies. Each genre has its own distinctiveness and degree of flexibility 'to respond to everchanging situations'. In responding to changes some genres vary and are structurally reshaped and/or rhetorically customized, while others just disappear and new genres and subgenres are born.

Across the six conceptual analogies of genre (understood in the broadest sense), the nature of contemporary scientific discourse proves to be sufficiently flexible and adaptable to the drives and social implications brought about by globalizing processes, transcultural flows and the increasing attention to the rich plurilingual landscape. The matrix of interrelating systems ruling contemporary scientific discourse in the age of globalization (Figure 8.3) illustrates how institutional, cultural and language issues influence science in the contemporary landscape. The matrix provides a thoughtful perspective of the metaphors of genres as living exemplars of several conversations, locally, intranationally and transnationally (or globally). More importantly, the matrix draws attention to the fact that it is not possible to disentangle these systems simultaneously governing scientific discourse in the globalization era. They operate at different levels and through different agents and for different reasons – from the merely scientific to the institutional, political, economic and educational – and all of them constrain and, at the same time, are reflected in the construction of scientific genres.

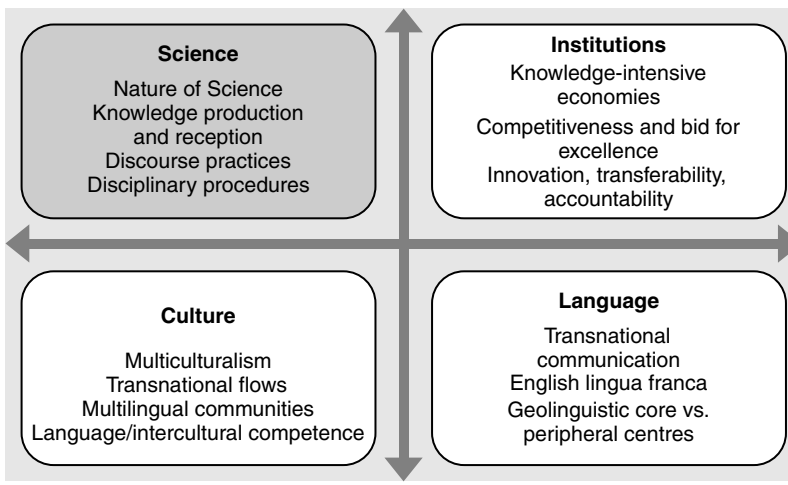

Figure 8.3 A matrix of interrelating systems influencing scientific discourse

Science itself is a crucial piece of the globalization mosaic. Domain-specific content knowledge is transferred in a more fluent, faster and easier way. Scientific communication thus represents a strategic multidisciplinary dialogue that fosters cooperation and joint efforts to address the intrinsic uncertainty and provisionality of the nature of science. Gee (1996, p. 148) argued that '[a] Discourse is an integration of saying, doing, and *valuing*, and all socially based valuing is political'. In the globalizing landscape, scientific discourse is a 'valued' discourse. Impacted by globalizing tendencies, scientific communication has become a valued commodity. As argued earlier, it is one of the key indicators for ranking the excellence of higher education and research institutions. In the broader sociopolitical context, it is a major economic indicator for measuring research output and for assessing the development performance of world economies. This evokes Baudrillard's (1970, p. 162) conception that '[t]he function of commodities, then, is not just to meet individual needs, but also to relate the individual to the social order'.

From a social-linguistics perspective, globalization yields evidence of dominant discourses and neoliberal ideologies yet it has also paved the way to a dramatic restructuring of world relations and a subsequent growth in cultural and linguistic diversity. In doing so, it has shown to problematize the interrelating systems of culture(s) and language(s). Multicultural communities are born out of growing transnational flows, with plurilingualism and multicompetence of L2 users (Cook 1991, Kecskes and Papp 2000) becoming key social issues in the political, economic and educational domains.

But the current globalizing scenario, with English as the leading language for communication, may be favourable to both international conjunctures and to counter-movements proclaiming cultural discovery. Focus on the peripheral centres incorporates a diversity of cultural models and represents pluralistic societies in the mosaic. It foregrounds commonalities across disciplinary communities using English, but also essential differences. As evidenced earlier with corpus data, linguistic and rhetorical variation demarcates different research-reporting narratives, preferred ways of argumentation and distinct culture-specific intellectual styles.

Critical perspectives have paid attention to the dominant core centres to bring to the surface the peripheral 'others'. Contemporary scientific networking triggers more solid cooperation, which should be based on a more equal footing. Scientific communication blurs social frontiers and allows – or, at least, has the potential – to enable scientists to come into contact with alternative cultural models, identities and values. More than a decade ago Mittelman (1996, p. 241) argued that neoliberal globalization was at that time 'the dominant force, and democratic globalization, a far less coherent a counterforce'. It may not be too naive to think that the globalizing tendencies at the turn of the first decade of the twenty-first century might be starting to gear towards a more democratic globalization. Indeed, genres have shown themselves to be

evolving in order to attain communicative purposes and in doing so they pose new problems and give rise to reflective stances about systems influencing scientific communication.

Towards New Forms of World Scientific Interrelatedness

In arguing that the concept of globalization is not unbiased as it involves 'processes which both homogenize and fragment within and between countries', Sjolander (1996, p. 613) encourages the search for a new paradigm for the particular domain of international relations. Sjolander raises concerns about the fact that world homogenization combined with increased polarization challenges a totalizing view of globalization in the sense that the latter 'creates difference and constructs "others" among us, despite its homogenizing pretences' (p. 616). As she further explains:

> Put most succinctly, while globalization does contribute in some respects to the homogenization of the world – through communications, technology, trade, investment and the construction of political choices – it also simultaneously heralds the end of the tendency of the modern era toward integration and convergence and does so through the incorporation into globalization of an increased polarization of society, both globally and locally. (p. 609)

Sharing similar arguments to those of Sjolander, Mittelman (1996, p. 3) explains that the dynamics of globalization brings to the fore such diversity and variety and hence establishes new forms of interdependence in and between societies by 'compressing the time and space aspects of social relations'. A similar perspective, though in the domain of social linguistics, can be found in Dewey (2007, p. 345), who stresses the role of 'others among us' and defines what he coins 'postmodern globalization' as 'characterized by more complex, multilateral forces, which is thus entirely compatible with a transformationalist account of the *diversity involved in the many varied local realizations* of global resources' (my own emphasis added).

In the context of scientific production, dissemination and exchange, globalization is not a neutral concept. In advocating world homogenization, the dynamics of globalization has drawn greater attention to the core vs the peripheral and has (almost) always revolved around economic interests – that is, those of knowledge-intensive economies – as the central target of action in global economies. But while it is true that totalizing views of the process disclose new forms of inequity at different operational levels, it is also true that new challenges come to the forefront: first, the conceptualization of emerging social relations within new time and space dimensions and, second, the construction of 'others', since not all peoples (scientists in this case) but only

'some' participate in cross-border flows of knowledge. Both challenges, as discussed below, indicate the need for an ongoing critical revision of the incipient establishment of new forms of world scientific interconnectedness.

Concurrent conversations are taking place both inside and outside the context of academia. On the outside, that is to say, in the open global milieu, knowledge economies are being promoted 'through research, technological development and innovation' (Commission of the European Communities 2007, p. 2). Not only global but also local economies are very much dependent on knowledge and innovation – hence the growing perception of scientific research production as a major form of capital. Universities and research centres are trendily labelled as manufacturers and large repositories of scientific knowledge. Supported by the current policies and politics of knowledge production and dissemination, knowledge-intensive economies have unleashed a new dynamics within the university context, one that pursues excellence and competitiveness that go beyond the mere altruistic 'manufacturing' of knowledge. Whether we like it or not, cutting-edge, innovative research is today the main thrust in the efforts of universities and research institutions to reach the top positions in the world ranks.

Inside the context of academia, conversations on science are acknowledged as an invaluable activity for the advancement of knowledge. As evidenced in a previous chapter in this volume, scientists' sites of engagement have always been and continue to be spaces where new scientific knowledge is generated and eventually textualized, disseminated and received. These sites are witnessing everyday processes of knowledge making and knowledge sharing and stand as spaces of interaction and, more specifically, for rich and meaningful dialogue within and across disciplines, with internet and the digital technologies playing a key role in local, national and transnational communications. Earnest dialogue entails willingness for an exchange of ideas and discussion on yet unsolved issues both within a particular domain-specific field and across disciplinary fields. This kind of more egalitarian and altruistic knowledge manufacturing taking place inside the context of academia should be brought to the fore when defining and establishing the new paradigms of international scientific communication. The different conversations in and about science – or, as it was put earlier, inside and outside academia, respectively – mirror Giddens's (1990, p. 177) observation that 'the globalizing tendencies of modernity are simultaneously extensional and intensional – they connect individuals to large-scale systems as part of complex dialectics of change at both local and global poles'. At this point, language(s) emerge(s) as a major concern for redefining the current paradigms of scientific communication. Different goals for ongoing scientific activity and different kinds of expectations from such activity arise in the cline of local-national, transnational and global spheres. Cutting across this cline, high traffic of knowledge exchange and global mobility causes conversation in/about science to be characterized by increased intercultural communication, which I briefly turn to below.

Broadly speaking, shared disciplinary practices and community procedures indicate that regardless of their cultural backgrounds and local languages, scientists form distinctive 'disciplinary cultures' with characteristic approaches to nature and diverse research styles (Becher 1981). These disciplinary cultures are the main contributors to the advancement of science – hence the need for educating and empowering scientists as competent intercultural communicators (Mauranen 1993b). Even if non-native-English plurilingual scientists, as was the case of the Spanish academics reported in Chapter 6, claim that 'they don't say what they know, only what they can', the use of English as an additional language allows non-native English-speaking scholars to participate in the global conversation of science. Then, is English a threat or an opportunity? The existing dynamics of scientific knowledge production and reception may be showing that English is more an opportunity than a threat if one wants, needs or wishes to participate successfully in global conversation. This view of scientific English discourse can reduce – or at least diminish to some extent – the reported conflicts between cultural values and blur the current excessively focused interest in core/periphery dichotomies and dominant/minority positions.

Much has been debated about questions of equity and lack of access across non-native English-speaking communities of scientific practice, but the questions posed actually challenge current scientific dialogue. While such dialogue exhibits engagement and exclusion both in discursive (language issues) and non-discursive requirements (lack of resources, etc.), the plurilingual scholars' struggle to join the mainstream may be challenging monolingual assumptions and institutional values in today's scientific communication. More importantly, this struggle opens a new window in the sense that it guarantees possibilities for mutual understanding as well as local and transnational interrelatedness. In short, mainstream monolingualism with attested linguistic and rhetorical variability may in the long run – if it has not already done so – turn into a form of mutual interdependence. Regardless of the language in use, the small-scale discourse practices and community procedures for scientific knowledge production across local research sites are those that make central the role of science in the age of globalization. Dis- or (mis)-regarding those practices as 'mesopolitical action', that is to say, as 'repeated social practices that mediate between social structure and individuated action' (Pennycook 2010, p. 29) does not grant credit or merit to those individuals participating in the creation and dissemination of scientific knowledge globally.

From what has been discussed earlier one may conclude that scientific English, as the main lingua franca for scientific communication, has been shown to facilitate the necessary dialogism to resolve intellectual problems, scientific dilemmas and facts of reality that are still unexplored. Therefore, claims of excessive dichotomizing and differentiation of centre-peripheral poles, predominant/endangered languages and cultures should be addressed cautiously

and always informed by evidence. Claims of deviations from the traditional L1 English monolingual standards should preferably pave the way towards rhetorical attunement, one rooted in individuals' and institutions' awareness of and responsiveness to rhetorical diversity and variety of ways and forms of communicating science locally, nationally and transnationally. It would then be desirable and not just wishful thinking that ongoing political, intellectual and scientific policies gradually start to accept peripheral participation. Overcoming cultural barriers for the pursuit of scientific advancement may increase social sensitivity towards the fact that languages are always shaped and reshaped by individual/community discourse practices. Similarly, sensitivity and respect towards cultural traits and traditions may make the politics of globalization solve the reported asymmetries of individuals with distinctive cultural and linguistic heritages across scientific research sites of interaction worldwide.

Rather than seeing the impact of globalization on cultural identities as an imperialist movement foregrounding mainstream practices, contemporary scientific discourse provides evidence that there is fluent communication between the native and non-native English-speaking scholars participating in the local, intranational and transnational scientific settings. It is true that different cultures and languages in the domain of scientific communication produce both convergences and divergences and that different cultures and languages may render, as suggested above, both opportunities and threats. Multiculturalism and plurilingualism have the potential to undermine the status of the dominant normative conventions in scientific communication. Perceived multiculturalism and plurilingualism may challenge the governing rules of communication by accepting alternative culture-specific traits and preferred rhetorical strategies in composing scientific texts. Focusing attention on the dominant actually empowers the non-Anglophone as 'others', whose plurilingual competence provides them with access to conversations that would not have taken place had they remained monolingual speakers.

As elsewhere, education here is a crucial policy instrument. Being critical of language uses and of the ways and forms languages are used in the production and dissemination of scientific knowledge needs to achieve greater footing across educational domains, particularly in higher education. Education should profit from a deeper focus on the critical debate of scientific communication across languages and cultures since full participation in global scientific communication is, needless to say, indispensable regardless of the rhetorical backgrounds and cultural and language experiences of the true producers and consumers of science. Attention thus needs to be given to perceived needs in education regarding learners' development of cross-cultural awareness. Such awareness can be raised, for instance, by analysing and interpreting critically processes of enculturation and by providing a rich instruction approach, based on real language usage models, of ways of communicating in and across different cultural contexts and languages.

Today, there is much to be gained regarding perceptions of language varieties if learners and instructors of scientific English*es* become aware of the threats and opportunities that plurilingualism provides. In the spoken mode, for instance, Seidlhofer et al. (2006) observe how the teaching of general language awareness, with the objective of raising awareness of how different languages operate in communities, has in some contexts begun to be put into practice. Approaches of this kind are imperative, since they move the initial focus away from individual languages in isolation to instrumental uses of languages in society. Both in the written and the spoken domains, providing scientists with exposure to mainstream and emerging varieties of academic English*es* and subsequent training in rhetorical strategies may make them better equipped to successfully interact within their local disciplinary communities and with the international community of their peers in the different meaning-making configurations mentioned above. This educational stance, if fully supported by policy makers, may guarantee possibilities for social and professional understanding and the continuation of the current fluid conversations in science.

Complementing plurilingual and multicultural education, there is a perceived need for increasing sensitivity towards multicultural and plurilingual diversity across the very producers and receivers of scientific knowledge. In the same way scientists' cultural experiences can render preferred textual developments when textualizing new knowledge claims, different cultural backgrounds can produce different interpretations of texts. Understanding 'how different varieties of English have developed linguistically and the ways in which they differ phonologically, lexically, grammatically, rhetorically and culturally' and understanding 'how English has developed in specific contexts and how it has spread across the world' (Kirkpatrick 2006, p. 33, cf. also 2007) is not only an advisable pedagogical practice for teaching/learning World English*es* and scientific English*es*. Sensitivity towards multicultural and plurilingual diversity can also become a valuable asset to the various kinds of scientific gatekeepers and institutional/governmental policy makers. Along with scientists themselves, such policy makers are, to some extent, co-producers and co-users of scientific uptake. Hence it is advisable that they engage in lenient stances towards the attested variety and diversity that contemporary scientific discourse practices substantiate.

Coda

An enquiry into the rhetoric of contemporary science dissemination suggests that the textual processes and products, the discursive practices within national and transnational disciplinary communities of interaction as well as the reception histories of scientific uptake should be seen holistically. Only a holistic

view can offer comprehensive insights into the rhetorical architecture of scientific discourse across cultural contexts and languages. What has been or might be envisaged as cultural collisions and global competitiveness can alternatively be seen as a growing linguistic complexity, with scientific English*es* putting forward communicative harmony and rich linguistic diversity.

When referring to the positive functions that the concept of culture can perform in the twenty-first century, Atkinson (2003, pp. 49–50) advocates the need for 'making the culture concept more flexible and reflexive' because it 'has traditionally been used to investigate difference, localization and cultural "purity"'. A reflective discussion on languages and local/global practices and on emerging realizations of multiculturalism in scientific communication needs to be addressed in a more focused way if we are to advocate that '[l]anguage is the only instrument of science, and words are but the signs of ideas' (Johnson, Samuel 1755. *Preface to a Dictionary of the English Language*). Cross-cultural contact will almost certainly continue in scientific communication. Therefore, ethical responsibility at all levels of communication and among all agents involved in it is required. After all, functionality and practicality in the world's scientific conversations should prime for the benefit of society in general and societies too.

Of the questions current EAP research and pedagogy could address, the following seem to be particularly important. The first question concerns the impact of multiculturalism in both local and global scientific communication. Recalling Giddens's (1999, p. 175) conception of globalization as one introducing 'new forms of world interdependence, in which, once again, there are no "others"', in contemporary scientific discourse, multiculturalism has problematized the traditional conception of the monolingual (English) speaker model. In addition, new culture-specific academic/scientific English*es* have partially contested the dominant English rhetoric and composition canons. The extent to which normative paradigms are being challenged by everyday language usage in scientific research sites worldwide thus needs further theoretical conceptualization. The second question concerns assessing the need for standardization and codification so as to find an egalitarian fulcrum between normative models and culture-specific traits for shared understanding. A definition of this fulcrum deserves careful research enquiry with a view to formulating appropriate pedagogical interventions in EAP teaching/learning environments. Intertwined with multiculturalism, the third question concerns plurilingualism itself as a major issue of research enquiry considering the economic, institutional and educational interests underpinning current social demands and transcultural flows – interests subtly defined by governments 'responses to global challenges and global competitiveness'. In every social sphere, as in the scientific arena, individuals need to adapt to professional challenges and to growing world interrelatedness. The account of the complexities of the geopolitics of language(s) at a micro- and a macro-scale

rendered in this volume brings to the fore the social role of language as the key instrument for scientific exchange and dissemination and lends credence that English-medium scientific communication does not only involve domination and resistance, but also adaptation and eventual hybridization in its linguistic, discoursal and rhetorical features considering the external forces operating at a macro-scale. A comprehensive description of culture-specific linguistic fingerprints in the repertoire of genres involved in scientific communication and longitudinal traceability of those distinctive fingerprints should necessarily be targets of future descriptive and experimental research in order to know the real scope of the 'go native' trend and the real extent to which new scientific English*es* permeate and destabilize the standard normative conventions.

It is therefore not possible to dictate a unique substantive conclusion on the impact and scope of culture(s) and language(s) on contemporary science rhetoric. Considering global trends and current cultural flows, it seems more sensible to seek research-informed and pedagogically valid ways 'to integrate and develop frameworks for a linguistics intercultural communication incorporating cultural value systems' (Clyne 1996, p. 1). The vast complexities of 'culture' and 'language' concepts need continuing theoretical and pedagogical examination from multidisciplinary research perspectives.

The interrelation between sociocultural, economic and political institutions and the production of scientific discourse calls for engagement in and attunement of interdisciplinary conversation involving EAP scholars, applied linguists, rhetoricians, communication specialists, discourse analysts, sociolinguists and pragmaticians. Informed by contrastive research across languages, examining ways scientists worldwide respond to arguments for academic recognition, promotionalism and acceptance by the community, for instance, and investigating the scientists' practices, perceptions and attitudes to English and, from a broader perspective, to contemporary transnational and transcultural flows in scientific settings may destabilize some of the neat formulations of English and globalization postulated so far. No doubt, the versatile nature and multipurpose goals of contemporary scientific discourse in the current social processes of 'transculturation' (Zamel 1997, Zamel and Spack 1998) and cultural borrowing and blending in the global village is a key source for furthering intellectual and scholarly debate. As Kraidy (2002, p. 191) succinctly puts it, 'a recognition that all contemporary cultures are to some extent hybrid is required to understand the micropolitics of local/global interactions'.

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