Language and Science

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Language and Science[1]

1. Introduction

Scientific communication is, as far as the relationship between language and science is concerned, certainly one of the most relevant fields of Applied Linguistics (AL). As a matter of fact, it is inter-subjective communication which makes science itself possible (see 2.1 for definitions of 'science'). What we mean by "scientific communication" here is that set of discourses whose aim is the transmission of knowledge and research results, performed by communication procedures which vary depending on who acts as sender (the scientist him/herself, the scientific journalist, the educator etc.) and who is the addressee (a fellow scientist, a student, the lay public etc.). Changes in such procedures mainly comply with social components of an economic, demographic and political nature which in turn have repercussions on the languages which compete with each other in scientific communication. Scientific communication in the era of globalization is a good field of observation of the competition in progress of most languages compared to English. The current transformations in scientific communication are not concerned only with choosing which language to use but also with the text types, the topic styles and the communication aims. The examples of this change in progress will be taken from the major Western languages which have a centuries-old tradition in scientific communication.

At a first glance it would seem that dealing with scientific communication consists in the analysis, the description and the interpretation of the linguistic structures and functions shown in scientific texts. This would coincide with research on language for professional purposes (LPP) and language for specific purposes (LSP), with which there are undeniable links. But what characterizes research on scientific communication is, instead, the need to analyze the language in much broader units of discourse, showing their relationship with specific social meanings. It is therefore appropriate to locate the analysis of scientific language in reference to particular sociolinguistic dimensions which influence lexical-grammatical and textual choices, and from whose interlacing the symbolic value of scientific communication arises**.** Thus, we can summarize the most typical aspects

[1] The entire chapter has been conceived by both the authors. In particular, E.C. has written the first half of section 1 and the sections 2; 3.1 and 4. A.C. has written the second half of section 1 and the sections 3.2-3.4; 5 and 6.

of scientific communication and, at the same time, define the issues discussed in this chapter as follows:

a) On a diachronic dimension (relating to changes over time), Western scientific communication provides a solid and centuries-old body of significant texts which span from modern times up to the present, with sharp changes not only and not so much on the lexical level but more on the sociolinguistic and pragmalinguistic level, especially where argumentative choices and type of text are concerned. The diachronic aspect will be touched on only marginally, with reference to the second half of the 20th century up to the present;

b) on a diatopic dimension (relating to geocultural variability), we must point out the peculiarities of "making science" in diverse and differentiated geographical areas characterized not only by typical linguistic choices but also by "local", national or deeply-rooted territorial cultural traditions. "Local" peculiarities inform the scientific procedures, which are in turn supported by their own traditions and needs which are firmly territorial. The "national" dimension of science must be further differentiated and evaluated according to the following traditional macro-disciplinary boundaries: humanistic cultures vs. scientific cultures, behavioral/human sciences vs. exact sciences, analytical sciences vs. rhetorical-argumentative sciences, etc. (see 3.4). The diatopic dimension of scientific communication today tends to be partly neutralized by the so-called globalization or internationalization, especially in those disciplines where the connection between science and technology and/or between economic and political power is most strongly felt. In this chapter we aim to highlight the major changes in scientific practices, as when a national type of communication shifts to a trans/international and globalized type of communication;

c) on a diaphasic dimension (relating to the variability of the communicative context), scientific communication is represented by a large number of texts, registers and styles depending on whether it addresses specialized, popular or pedagogic issues (see 2.3). We will mainly regard primary or intra-specialist scientific communication (see section 3);

d) on a diamesic dimension (relating to the channel of communication), written and oral scientific communication differ from one another in the same way as verbal communication in general selects distinct grammatical and stylistic patterns depending on the needs for speaking or writing. Up until now written scientific communication has been studied much more than spoken scientific communication. We will provide a critical summary of the phenomena and of the problems linked mainly to written scientific communication and we will only occasionally skim over spoken scientific communication.

With reference to the classic definition of AL by Grabe and Kaplan (1992: 3) where "Applied Linguistics […] is a field the purpose of which is to solve real-world language-based problems", we will define two major fields of AL:

1) The style of scientific prose as it is conditioned by sociolinguistic, cultural and historical variables;

2) Scientific research between local and international needs and the language of scientific communication between monolingualism and multilingualism.

While applied linguistics has traditionally been concerned with the first issue, it is only relatively recently that the latter has begun to be more carefully observed. It is also for this reason that we will put more emphasis on the second issue.

2. Outline and history of the field

Of the complex relationships between language and science the phenomenon of scientific communication is only one of the relevant aspects from the viewpoint of current language sciences - in as much as it is, probably, the most widely discussed aspect outside of a strictly linguistic context. Before going into this question, however, it is necessary to explain what is meant by 'science'.

2.1. Definitions of science(s). 'Science' is a complex and fleeting problem. In the sociology of science the multireferentiality of the term has been clearly defined: 'science' "is commonly used to denote (1) a set of characteristic methods by means of which knowledge is certified; (2) a stock of accumulated knowledge stemming from the application of these methods; (3) a set of cultural values and mores governing the activities termed scientific; or (4) any combination of the foregoing" (Merton 1996: 267).

From the viewpoint of the "object" of science, there is a significant differentiation between most of continental Europe and the Anglo-Saxon world. In the latter, in fact, the current concept of 'science' can be summed up by the following definition: "[science is] the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment." (N.O.D.E. 1998: 1664). The object of scientific research is therefore essentially identified with that of natural sciences, whereas, in the tradition of continental Europe (closer to the meaning of the corresponding Greek and Latin terms) science is considered any activity of research aimed at producing knowledge, acquired through studying, experience and observation and therefore corresponds to a constructed combination of ordered, coherent and interdependent knowledge. The first important consequence of these conceptual or ideological differences is clearly the problem of what human and social sciences correspond to. The problem is actually already linguistically codified in various languages: in English these sciences are referred to with the single term 'humanities' (and so we already have an important terminological boundary between *science(s)* and *humanities*), while in most of the other European languages expressions containing a term corresponding to 'sciences' are normally used ('sciences humaines' in French, 'ciencias/ciências humanas' in Spanish and Portuguese, 'scienze umane' in Italian, 'Geisteswissenschaften' in German, 'gumanitarnye nauki' in Russian, etc.). Of

course, even if not all scientists in the English-speaking world share this exclusion of human /behavioural sciences from the field of what is considered "true" science (e.g., Ziman 2000), the situation today is such that many are beginning to express concern that "the use of English as the scientific language may lead to a too restricted idea of what science is" (Hauge 1996: 166). In this chapter we will adopt the broader "continental" definition of science, by which we mean the research procedures and the systematization of knowledge which make it communicable, codifiable and progressively updatable.

2.2. History of the field. From a historical viewpoint, we must remember that the first systematic discussions in modern times of the relationship between language and science, or more precisely, between language and knowledge (lat. *scientia)*, were still fully part of philosophy and also that the distinction between philosopher and scientist is a relatively recent one (until the 1700s the equivalent of the current term 'scientist' was 'natural philosopher'). For instance, the proposals and the creations of the "*a priori* philosophical languages", imagined as a universal and perfect tool for transmitting ideas and also for discovering new aspects of natural and intellectual reality (Eco 1993), belong to the philosophical sphere. Semiotic and metalinguistic reflection has been present, in a more or less articulate or persistent way since the very beginning of modern science in the writings of Francis Bacon, Jan Comenius, Galileo Galilei, René Descartes, Gottfried Wilhelm Leibniz and many other well-known fore-fathers of modern Western science. Nowadays, instead, perhaps due also to the growing diversification of the disciplinary fields, natural scientists seem to be less directly involved in the metadiscursive and metalinguistic reflections which regard their discipline, leaving this field open to other experts of "metascience", such as historians, philosophers, sociologists and, although in a minor way, to linguists and language historians. In fact, a "linguistics of science" does not exist, whereas the philosophy of science and the sociology of science do. In particular, at present, "sociology has superseded philosophy at the theoretical core of 'science studies'" (Ziman 2000: ix). It must, however, be noted that, especially since new scientific discoveries began to take on an alarming role in the second half of the 20th century (mainly in the military and genetic fields), scientists themselves are gradually paying more attention to how their work is perceived by the lay public. This brings about in the scientists themselves a growing awareness not only of the foundations of scientific research but also on the *methods* of transmitting new scientific knowledge, on the publicizing of and thus on the discourse itself of science. It is, however, remarkable that, parallel to discussions on science by scientists, such as the physicist Ziman (2000), who show a considerable awareness of the problems connected to a purely instrumental vision of scientific language, many of the statements by natural scientists go in practically opposite directions, often expressing a simplified, purely instrumental and economic approach to the linguistic problem. Therefore, we often have a vicious circle: the scientists's

forays into metalinguistic issues often appear limited or artless to the language expert, and in the same way the applied linguists' forays into the world of science risk appearing just as limited and artless to the shrewd scientist. Of course, in the framework of current language sciences, it is not only applied linguistics which is concerned with the relationship between language and science.

It is useful to make a distinction between two different aspects of the relation between language and science: a) the cognitive aspect, namely the way in which language is in itself a tool of knowledge, which provides cognitive strategies that help to interpret and reconstruct the real world; b) the social aspect, namely the way in which language is a tool for the transmission of knowledge. These two aspects are in fact inseparable.

In compliance with today's disciplinary boundaries, the cognitive aspect is still placed in the foreground especially by philosophy of language and by recent cognitive linguistics. On the other hand, the social aspect is placed in a central position especially by sociolinguistics, pragmatics and applied linguistics. In this chapter we will take a wider view of applied linguistics which also includes sociolinguistics and pragmatics as these are areas which are directly concerned with language use in real contexts. During the last decade two lines of research have been particularly relevant: the rhetorical analysis of scientific writing and the linguistic analysis of scientific genres. The first, essentially diachronic, on language and on rhetorical-argumentative strategies of scientific discourse, contributes to showing how knowledge is constructed not only empirically, but also by means of rhetorical argumentation (cf., e.g., Bazerman 1988 and Atkinson 1999 on the evolution of scientific discourse in The Philosphical Transactions of the Royal Society; Altieri Biagi 1990 on Galileo and other Italian scientists between the 17th and 18th centuries; Gross, Harmon and Reidy 2002 on the historical evolution of the scientific paper in English, French and German from the 17th century onwards). The second line of research analyses scientific/academic writing in the framework of textual genres (Swales 1990; Hyland 2000).

Due to socio-cultural reasons (the greater prestige which is attributed to writing) and strictly technical ones (the greater difficulty in gathering and analyzing spoken data), most studies on scientific language are based not only on written language but also on a specific genre (the scientific paper) and on a restricted selection of disciplines (mathematical, physical and natural sciences). The pedagogic aims of such types of study often run the risk of being excessively simplified and it is quite frequent, especially in certain kinds of manuals, to find scientific language reduced to a sort of jargon or language for specific purposes whose peculiarities are usually described as being restricted to a formulaic set of lexical, morphosyntactic and textual features.

Scientific communication, as a topic of study, is therefore at the crossroads of many disciplines (history of science, philosophy of science, sociology of science, rhetoric and linguistics), and sub-disciplines (sociolinguistics, pragmatics, applied linguistics). Therefore, a study of scientific language within one field, e.g.

applied linguistics, will also have to consider interdisciplinary perspectives. Naturally, this holds also true in the case of qualitative as well as quantitative research on the different (national and international) languages employed in scientific communication. In this case, other disciplines (e.g. economics and politics) also become relevant when issues such as the democratization of knowledge and its costs, or the current competition between languages in the era of globalization come into play.

In both cases, whether the concern is with internal characteristics of the language of science or with the competition between languages in national and international scientific communication, the linguistic and metalinguistic observations of the main protagonists, the natural scientists themselves (e.g., physicists such as Lévy-Leblond 1996, Ziman 2000, or biologists such as Valiela 2001 etc.) are anything but secondary.

2.3. Types of scientific communication. Two major models of types of scientific communication can be defined. The first model distinguishes between *primary* scientific communication, i.e. the transmission of research results among specialists, and *secondary* scientific communication, i.e. the transmission of scientific knowledge by specialists and/or semi-specialists (e.g., journalists or instructors) to the lay public, for pedagogic purposes and for popularizing in general. The various studies in Ammon (2001a) often refer to this binary distinction. The second, more complex model (Cloître and Shinn 1985) provides for a sort of *continuum* from which four main levels of scientific communication or, in their words, of 'expository practice' emerge:

1) the *intra-specialist* level of the communication between experts and researchers from the same field; its typical written means is the paper, especially in the fields of mathematics, physics and natural sciences, whereas in the social sciences and the humanities written communication takes the form of papers, books and monographs; 2) the *inter-specialist* level, where communication takes place among researchers and specialists from different fields or different sub-sectors of the same field; typical examples of written transmission are the articles in the so-called 'bridge journals' such as the British *Nature* or the American *Science*, which in turn function as a model for similar publications in other countries; 3) the *pedagogical* level, which concerns transmitting scientific knowledge for pedagogic purposes; the typical means of transmission in this case is the textbook; 4) the *popular* level, where scientific knowledge is broadcast to a wider lay public through the mass media such as television, or, in the case of written transmission, through the daily or weekly press, or through publications specifically designed for mass scientific popularization.

Finally, combining the distinction between spoken vs. written and three levels of formality, a useful and concise model is provided by the physicist Lévy-Leblond (1996: 238, original in French; see also Gutiérrez Rodilla 1998: 20), cf. Table 1:

Tab. 1 Forms of scientific communication (from Lévy-Leblond 1996: 238)

	Informal communication	**Institutional** communication	**Public** communication
written communication	Laboratory diaries, correspondence, etc	Specialized publications	Popularization (books, papers)
spoken communication	Work discussions, telephone conversations, etc	Talks, seminaries, press conferences	Teaching, media (radio, TV)

3. State-of-the-art: central concepts and theoretical approaches

As already stated in section 1, we will make a distinction between two major fields: the one which AL traditionally deals with, regarding the description and the analysis of scientific language as a variety of usage of a certain language (see 3.1), and the one concerned with which languages are used to transmit scientific knowledge in national and international contexts (see 3.2). The great relevance of this second field for AL is given by the direct relation between the changes in *status* of a certain language and those of the *corpus* (in terms of the system and of the norms). The growing predominance in scientific communication of a certain linguistic system, e.g., English, which inevitably brings with it specific discourse models and a certain sociology of knowledge (Kaplan 2001:12), causes, more or less rapidly, changes also of a lexical, morphosyntactic, textual and rhetorical type in the scientific language of the national non-English-speaking communities.

3.1. The description of scientific language. One of the main problems when describing scientific language is how to categorize it in relation to the other linguistic varieties inside the diasystem they all belong to. If, for instance, scientific language is treated only as a professional jargon this implies: a) that there are no particular ontological differences in *status* between the specialized language of a biologist and the equally specialized language of a stockbroker; b) that the field of its users and that of its scholars is restricted only to those who have a specific working interest in it (scientists, science students, teachers of scientific subjects, translators and specialized journalists). Scientific language, however, beyond the most striking external aspects (lexical ones in particular) which often give it the obscurity of a downright jargon, is instead a type of language which has a broader social and cognitive relevance. It is indeed the language of "complex thought" which reconstrues experience and construes knowledge, and, according to Altieri Biagi (1990: 192-193), should be defined in a balanced three-way relationship with common language on the one hand, and with literary language on the other: both scientific and literary language represent the tools of complex thought which pursues knowledge from the viewpoint of objective perception (scientific language) and of subjective perception (literary language). Along the same lines Halliday (2004: 95; 160) observes that "the

languages of science are not saying the same things in different ways" and identifies two extremes in the attitude towards scientific language, one which makes it coincide only with technical jargon which can be perfectly (and hopefully) transferred "in[to**]** the everyday language of ordinary common sense", and the other which instead makes scientific language coincide with science itself, denying thus the possibility to "separate science from how it is written, or rewrite scientific discourse in any other way". Of course, as Halliday concludes, reality is to be found somewhere in the middle of these two extremes.

Descriptions of scientific language are often triggered in the theoretical framework of languages for specific purposes (as professional "sub-codes") mainly because it is the lexical aspect that tends to be emphasized as the most dissimilar feature when compared to common language. But to deem that scientific discourse coincides with specialized vocabulary, instead of representing complex linguistic relations of an argumentative type (cf. e.g. Walters 1996: 36-37), is an enormous simplification. It is thus necessary to put the lexical aspect back into perspective with regard to the other aspects of scientific language, such as grammar and textual organization. As Halliday puts it: "we shall need to get rid of our obsession with words. The difficulty [of the language of science] lies more with the grammar than with the vocabulary" (2004: 161).

In order to establish which norms of usage are at work in the scientific language of any natural language, there are at least two complementary approaches (Calaresu 2006). The first is based on what scientists themselves actually say and hope for, and the second on what the analyst can actually find as recurrent and systematic in the existing scientific texts, both from the past and from the present day. As for the first approach, what scientists themselves demand**,** more or less systematically (from Galileo to Einstein to modern scientists), is "simply" the most accurate and non-ambiguous use possible of the language itself, i.e. consistency of terminology, clear explanations and, as far as possible, being more objective than subjective (at least where observation procedures and analysis of the phenomena being researched are concerned).

As for the second approach, what can be actually found in the scientific texts themselves, paying attention to the historical development, is a certain recurrence to or preference for certain linguistic solutions such as a widespread use of nominalizations and passive tense constructions in the descriptive parts, a narrative structure of the summary of the experimental stages etc. As a matter of fact, the textual and rhetorical standardization which we are used to today because of the style of current scientific papers (particularly in the case of natural science) is a product of history and the linguistic-textual structures of scientific works have changed remarkably over time from Galileo's dialogues to today's *scientific papers*. The common repertoire of recurrent linguistic solutions notably increases if the linguistic and textual analysis is of a purely synchronic type, i.e. if it regards a specific moment in history such as the analysis of scientific texts of the second-half of the 20th century. In this case we would find these characteristics: avoiding

the use of "I" and preferring impersonal structures, a strict order of the components (e.g., Introduction, Materials and methods, Results, Discussion and Conclusion), certain standardized procedures of quotation and hedging, a certain type of textual and graphic layout (paratext) etc. (see Atkinson 1999:75-102). Moreover, despite a widespread popular misbelief **(**which is however also shared by some scientists), scientific language has always been rather full of metaphors and even based on metaphors most of the time: "indeed, the history of a scientific discipline can be traced through its changing repertoire of models and metaphors" (Ziman 2000: 150).

All these facts challenge many "naive" presumptions on the language of science (presumed objectiveness and lack of ambiguity) which the analyst should beware of. In fact, the two different approaches are often easily confused, describing as real features of the language of science characteristics which instead correspond to its ideal "aims" (precision, neutrality and conciseness, see Gutiérrez Rodilla 1998: 30-37). Such a misunderstanding often contributes to spreading a not very realistic (and paradoxically, not very objective) vision of "making science", as well as to coming to inappropriate conclusions on the *reasons* for choosing one language over another to transmit the results of scientific research. This occurs, for instance, when we attribute to the different languages internal or intrinsic natural characteristics which make them more or less suitable for scientific discourse, and/or attributing to a specific language characteristics which instead correspond to the *ideal* aim of modern scientific research. Below we will give an example of this by quoting three different explanations on the use of English as the language of scientific communication. The first two (which represent the most widespread opinion today) are, respectively, taken from the discourse of an applied linguist who is a native-English speaker (1), and of a marine biologist, who is a non-native English speaker (2), and the last, which exemplifies instead a sounder linguistic realism, is of a native-English speaking physicist (3):

(1) *La diffusione della conoscenza scientifica è basata in gran parte sul linguaggio. La metodologia scientifica intesa come oggettività, ricerca sistematica ed elementi di misura esatti ha determinato lo sviluppo di un linguaggio specifico caratterizzato dalla forma impersonale, dalla logicità della esposizione e dalla precisione della descrizione.* ***La lingua inglese si presta particolarmente a soddisfare tutti questi requisiti nel loro insieme e ciò ha determinato la naturale preferenza attribuita all'inglese come mezzo di espressione scientifica internazionale*****.**

The spreading of scientific knowledge is mainly based on language. Scientific methodology understood as objectiveness, systematic research and elements of exact measurements has determined the development of a specific language characterized by the impersonal form, the logicalness of the explanation and the accuracy of description. **The English language is particularly suited to meeting all of these requirements as a whole and this has determined the natural preference attributed to English as a means of international scientific expression.** (Ulrych 1991: 75, original in Italian, our translation and our emphasis)

(2) The preeminence of English as the scientific medium of communication comes about from

economic affluence, **relative ease of use, large vocabulary, brevity**, and number of speakers. [...] The richness, **exactitude**, and brevity of English, in combination with accidents of history and response to technological development, have therefore conspired to spread use of English to many people all over the world, and to establish this language as the international language of science. (Valiela 2001: 103, 107; our emphasis)

(3) Scientific discourse is not really distinct from other 'didactic' modes of ordinary speech. The sloppiness and diversity of natural languages is thus a very serious challenge to the norm of universalism. Scientists think, speak and write in a variety of languages [...] How is it possible to formulate and communicate clear-cut scientific theories in such inexact media? [...] Yet this challenge is met and overcome daily throughout the scientific world. It has not been necessary to banish natural languages from scientific discourse**.** It is true that English has become the principal international language of modern science. But English is not the language in which the majority of scientists commonly think or express themselves to their immediate colleagues and has not superseded other languages for the formal communication of research results. **Anyway, English is just as inexact, ambiguous, irregular and idiosyncratic as any other language on earth - except in its spelling which is uniquely disorderly**. **In practice, the universality of science is enabled by the universality of certain structural features of all human languages**. (Ziman 2000: 135-136; our emphasis)

Of the three authors quoted above it is precisely the applied linguist who attributes the spreading of English only to internal linguistic characteristics of this language (English's alleged greater suitability to logic and precision compared to other languages), whereas even Valiela himself recognizes, more realistically, that there are also socio-economic reasons which run parallel to presumed intrinsically greater linguistic virtues of English.

3.2 English as the language of science. English's spreading as an international language began after the first world war and after the second world war it became the main language of tertiary education and scientific publications (Ammon and McConnell 2002). The phenomenon only became a theme of systematic research from the mid-70s' onwards when a new sensitiveness to language phenomena in contact and in conflict, and in particular towards forms of linguistic expansion and colonization, arose. The feared change was deemed not only paradoxical but also a source of peril for the scientific creativeness of the local-national traditions (Moles 1979). The perception of the loss of functionality was greater in those linguistic communities characterized by the so-called "languages of culture", and it was in France and Germany that a new line of sociolinguistic research began. Its main issues were the identification and definition of indicators of the *status* of a so-called "international language", the relationship between *status* and *corpus* and the possible consequences of linguistic hegemonization. In fact, despite the close ties between *status*, *corpus* and acquisition planning, the wealth of functional varieties of a language and its *status* do not coincide precisely and the attributes of international language and *lingua franca* are often used very superficially to describe the same phenomenon. A *lingua franca* as such is not the native language of any of the interactors, but just as frequently we read that English has taken on the role of *lingua franca* which once belonged to Latin (cf. e.g. Graddol 1997 or

Crystal 1997; see section 4). As for the degree of "internationality" of a language, we can easily make it coincide with the *cratic* dimension, i.e. the degree of power held by the linguistic community in question (Gr. *kràtos* = power). The English-speaking community fully satisfies demographic, political, cultural etc. indicators which contribute to increasing English's function as a transnational, international, world, global, universal, propellent, widely-communicated, hypercentral, additional language etc. (cfr. Crystal 1997, de Swaan 2001, Brutt-Griffler 2002). As linguistic functions and usage set off a self-reproductive mechanism (known also as the *Catherine wheel model*), the growing use of English in scientific communication and academic contexts appears more and more like an unrelenting wave. The main line of research aims to describe and to measure the size, the causes and the effects of this change.

3.3 The loss of scientific registers of languages other than English. The pioneers of this sector of research are Thogmartin (1980), Tsunoda (1983), Baldauf and Jernudd (1983). This latter study also discusses the researchers' apparent lack of interest in the issue: "although language of publication is an inescapable feature of scientific communication, it is most often treated as background noise, a variable in which neither information specialists nor scientists have shown much interest, nor is it, as far as we can tell a problem which linguists have examined" (97). Tsunoda (1983) records the change in linguistic usage in the field of natural sciences over a whole century (1880-1980) showing an advancement in the strong spreading of English detrimental to German and French which starts off slowly from 1930 and which is exponential from the 1950s onwards. Just to give some actual examples of the spreading of English, by means of data gathered by Laponce (2001) and added to by Sano (2002) with reference to *Chemical Abstracts*, in the period 1978-2000 there is a noticeable increase in publications only in the Chinese language, whereas there is a sharp decline in the other important languages of culture such as French and German. Russian, stable until the fall of the Soviet regime, also shows a decline after that date, while the quantity of publications in Japanese, although a small percentage of all publications, remains stable over time. The percentage of papers in English has almost doubled, from 43% in 1961 to 82% in the year 2000. The apparently positive information on the increase of publications in Chinese is evaluated by Laponce (2001: 61) within a general trend of a transition period "marking the entry of Chinese scientists into the worldwide market of science". As for human sciences, the predominance of English can be observed "even in a language-sensitive subject such as linguistics, where in 1995 nearly 90 per cent of the 1,500 papers listed in the journal 'Linguistic Abstracts' were in English" (Crystal 1997:102).

While in the 1980s sociolinguistic surveys were still limited to single disciplinary sectors (such as sociology, psychology or medicine), from the 1990s onwards a thorough framework for human sciences and for physical-natural sciences was made up (Ammon 2001a, Carli and Calaresu 2003, Carli 2006).

Despite using highly-divergent methods of data-gathering, description and interpretation, a comparative framework for ample disciplinary sectors and for various geo-cultural areas has been obtained (cf. Skudlik 1990 and Ammon 1991, 1998, 2000 for the German-speaking areas; Conseil de la Langue Française 1996, Locquin 1989 and Truchot 1996, 1997, 2001 for the French-speaking areas, Gutiérrez Rodilla 1998 e Gimeno Menéndez 2003 for the Spanish-speaking countries, Carli and Calaresu 2003 for the Italian-speaking areas; Ammon 2001a for many countries of the Western and Eastern world).

Data banks can also be considered useful bibliographical tools even if most of them are run by Anglo-Saxon editors who are therefore more inclined to register scientific production in English. According to the *Science Citation Index* (SCI), the largest bibliometric repertoire of the ISI (www.isinet.com), 90% of all of the papers included are in English. Not only the developing countries but also countries which have advanced systems of education are rarely, if at all, present. Many studies identify a conspicuous series of chain reactions linked to the introduction of the evaluation criteria of the *impact factor*, or IF (on which the SCI is founded). IF is a bibliometric criterion for measuring the visibility and diffusion of a scientific journal (for a review on its presumed "objectiveness" see Valiela 2001: 102; Carli and Calaresu 2003: 55-58). Even if language does not appear among the criteria for the calculation of the IF, it is really a covert extenuating circumstance that has repercussions on the scientific communities by forcing them to publish in English (Truchot 2001: 320; Carli and Calaresu, 2003: 55-60). In fact, an increase in IF is associated both with the prestige of a journal and the ability to attract the best authors, and the great majority of journals with the highest IF are in English. Thus, especially in the biomedical field, many scientific journals, traditionally edited in languages other than English (and at times also well suited to being published in other languages as well as in English), try to reach a higher IF simply by switching to English as the sole language accepted for publication (see also Ammon 2001b: 353-355).

Summing up, the following trends emerge:

1) English as the language of scientific communication is by now an inexorable and relentless presence, and has been mainly since the 1990s; its systematic introduction has produced reactions which vary greatly depending on the peculiarities of various cultural traditions. As far as Europe is concerned, there is a huge differentiation between Northern-European countries such as the Netherlands and Scandinavia (where English spread very rapidly and without much opposition from the 1960s, cfr. Gunnarsson 2001, Haarmann-Holman 2001, de Bot 2004) and the Mediterranean countries (where English began to dominate only from the mid 1990s, Carli and Calaresu 2003); the most intense critical perception began within the ex-major scientific communication languages: French and German;

2) there is still a certain differentiation of results between natural sciences, where the use of English is more than 80%, and the human and social sciences

where the use of English varies between 50% and 20%;

3) the single national languages are still used mostly in secondary scientific communication, giving rise therefore to a wholly internal diglossia of scientific communication: the primary communication is in English and the secondary communication is transmitted in the national languages but with a strong inclination towards English, especially where tertiary education is concerned, as a consequence of "internationalization" procedures (Ammon 1988, 2000, 2001a, Ammon and McConnell 2002).

3.4. National vs. disciplinary culture. English is often championed by a consistent number of researchers to overcome the differentiation of identities and cultures subtended to the single languages. This current of thought tends in fact to consider linguistic variety as a bothersome accident or a professional misfortune which can only be put right by using a single language. English is almost automatically attributed with the intrinsic features of a neutral, practical language highly suitable to widespread communication which is said to be characterized by reaching universally-shared technical-scientific knowledge (see 3.1 & section 4). This is obviously in contrast with the growing awareness of the peculiar cognitive and cultural traits of every language, English included. According to this view, every language proposes its own semiotic system and its own interpretation of facts and even English is inevitably linked to its own traditions and cultural beliefs. The most obvious of these, according to Pennycook (1994), is to think that scientific language is able to describe facts "objectively". Hyland (1997: 20) says that English as a scientific language contains, on the contrary, a twofold ideological strand: one is linked to how the facts are read and the other to how the discourse is articulated.

National and disciplinary scientific communities are subject to four types of influence. The first is how the textual and rhetorical organization of natural sciences discourses influences those of social and human sciences. The second is how the scientific style of discourse of the English-speaking countries affects that of the other countries. The combined effect of these two aspects is that English scientific discourse which characterizes natural sciences has become a model for scientific discourse itself. The third type of influence concerns, instead, the impact of the social construction of science information in the English-speaking countries (the USA in particular) on that of the other countries: "the international information systems are organized according to an English-based sociology of knowledge. Even research and development (R&D) functions in non-English states are impacted, since it is necessary to be able to search scientific literature in English and according to its sociology of knowledge" (Kaplan 2001:12). The fourth type of influence is how the methods and the agenda of scientific research of the "leading" countries affect those of the other countries. We will give two brief examples which show how research methods and exposition procedures are impacted by English scientific models and how these models can affect the shape or composition of national scientific communities. The first example is the gradual

abandonment of a whole textual genre in medical research, i.e. the exposition of single case reports, which used to be well represented in the medical journals of European countries but which is disappearing due to the low repute and low IF it has in USA medical research (where surveys based on high numbers and statistical procedures are preferred) and as a consequence it is less and less represented in international medical data banks (Carli and Calaresu 2003: 43-44). The second example concerns humanities and the procedures of establishing authorship in countries such as Italy. The evaluation norms of humanistic research in Italy still require that a paper or a book, if written by two or more authors, should declare (in an initial footnote, as we have actually done in this paper, or at the end of each major part) who is to be considered the author of which part; otherwise the single researcher may not be evaluated for his/her contribution to that work when all his/her scientific production is being evaluated for career advancements. This authorship procedure usually conflicts with the norms of English scientific papers but its breach can cause some problems to those researchers who are not yet at the peak of their professional career. As for the impact on scientists' professional careers, de Swan (2001: 78-79) further observes: "The hegemony of English in the social sciences (and in other fields) has yet another consequence, that is mostly ignored. Academics are required to publish regularly in 'international' and 'refereed' journals. In actual fact, these are almost without exception American and British periodicals. As a consequence, American and British editors and referees judge contributions from scholars all over the world and in so doing - without ever having intended to - exert a major impact on the selection and the promotion of academics in other countries who depend on these publications for their career advancement.".

As for the connections between the academic communities and their texts, the language sciences, AL included (as mentioned in section 2), have so far been concerned with the organization of information and with the rhetorical-stylistic dimension. AL in particular has dealt with the experience of academic writings for the non-native speaker (NNS) (Flowerdew 1999, Hyland 2004). However, a most promising new line of research, called *Cultural Identity in Academic Prose* (KIAP, Norwegian abbreviation; cf. Melander, Swales and Fredrickson 1997; Fløttum 2003), has recently been initiated. It aims to reveal the links with national or disciplinary cultures in scientific prose. Dahl (2004), for instance, has worked on a corpus of scientific papers taken from three different fields (linguistics, economics and medicine) and in three different languages (French, English and Norwegian). Her analysis aims to verify if argumentative and metadiscoursive features are linked more to the disciplinary sector or to the national language/culture. In fact, Dahl does not consider the NNS, but expressly "the writing of professional scholars in their native language" (1809). Two possible results emerge from Dahl's linguistic survey: 1) in the field of medicine the metatext/metadiscourse is a marker of the disciplinary culture (i.e. not of the national culture or of the language employed); 2) in the fields of economics and linguistics, on the contrary, the

metadiscourse and the argumentative style are linked to the writing tradition of each single language, and national culture prevails over disciplinary culture. Further analysis of the data reveals greater similarities between English and Norwegian culture and both are less similar to French culture.

Although this type of research is very interesting, it must be observed that the concepts of "culture", "identity", "cultural/disciplinary model", and "style" are often used too vaguely and that further investigation on bigger corpora is needed. The results of such surveys confirm however the differences between humanist and naturalistic disciplinary cultures. Currently, the latter are more inclined to fit into a more globalized cultural model, but there is still a need to verify the influence that technologies, which natural sciences are closer to, can have on knowledge models and on linguistic usage.

4. Controversial issues

One of the most pressing questions today is whether science really and intrinsically *needs* a single language or if monolingualism in the scientific field is just an extenuating historical circumstance. A simply "horizontal" survey of current scientific production would give the overall impression of a peaceful convergence on the "free" choice of a single international language. If this were the case we would have to deem that the problem exists only in the preoccupations of a fringe of scholars, typically represented by applied linguists and sociolinguists, as well as in the more conservative sectors of public opinion in countries whose language is declassified by another one. However, what emerges through secondary textual genres, such as letters and editorials in scientific journals (typically when a journal decides to change to English as sole publication language, cf. Carli and Calaresu 2003: 49-52, 54) shows that a debate still exists and that it is far from being resolved on unanimously-shared points of view.

4.1. The need for a "universal" language for science. The criterion of "universality" in science regards at least three different levels: methodological, ethical and linguistic. Only on the first level universality can be considered an *intrinsic* necessity of science: a certain theory needs in fact to be "universally" valid, i.e. internally consistent and, given a certain protocol or set of parameters, its results must be generally applicable and repeatable. Universality (or "universalism") as an ethical norm means instead that "[t]he acceptance or rejection of claims entering the lists of science is not to depend on the personal or social attributes of their protagonists; their race, nationality, religion, class, and personal qualities are as such irrelevant." (Merton 1996: 269). However, if a theory or a result do not meet the requirements of methodological universality they would no longer be considered science but non-science or pseudo-science, whereas the eventual breaching of the ethical norm of universalism (rather frequent in periods of international conflict) regards the socially and ethically reprehensible attitude of a certain scientist, or of a certain school, without

necessarily challenging the scientific results as such.

Universality with regard to the language of science concerns two different issues (Calaresu 2006), but in neither case does it help to distinguish science from non-science, i.e. a scientific work is not in itself less scientific only because written in a natural language rather than in another. The first issue is related to the constant dream of a language which, unlike natural languages, is constitutionally lacking in ambiguousness and subjectiveness, so as to better meet the referential precision and the objectiveness which we require from science (cf. the search for the perfect language of knowledge, in Eco 1993). The hopes of being able to use a highly formalized and not necessarily verbal language, e.g. a mathematical language, are still alive today, but many scientists dismantle such an ambitious prospect at its base (cf. Lévy- Leblond 1996: 237; Ziman 2000: 139-140, 149-150, cf. also the example [3] in 3.1). The second, less philosophical issue concerns how useful, advantageous or even necessary it is for science to have at its disposal a sole international vehicle of language. Even if the concept of a "universal" language and that of a globally "international" language are completely different, the two terms, as already stated, are frequently used as synonyms and it is often said that English is by now the "universal" language that Latin once was for science and research. Strictly speaking, both Latin and English are undoubtedly international languages but neither Latin nor English could be defined "universal" (as is the case, as far as we know, for all verbal human languages of the past and of the near future). From our data on medical journals (Carli and Calaresu 2003), the use of English/Latin parallelism is particularly frequent as a form of justification and promotion in critical (and at times dramatic) moments when passing from Italian to English as the sole language accepted by the publishers (but the same parallelism is also found in Valiela 2001: 103, 107). There are at least three different reasons to reject this type of parallelism (Calaresu 2006): 1) as already mentioned, English is not (yet) a *lingua franca*, and still has many native speakers; 2) English is not the language of primary alphabetization of the entire international scientific community, while medieval Latin was; 3) the different nature of the relationship with the various local/national languages with which Latin once contended and with which English contends today the fields of use. In fact, as far as scientific communication is concerned, there was, historically, a path of linguistic differentiation from the exclusive use of Latin to the use of the different national languages. The current situation is just the opposite, i.e. a case of growing convergence on a sole language, and the field of scientific communication, which was once the main goal of national languages with regard to Latin, is today one of the first which English snatches from the national languages.

However, a comparison between the use of Latin and that of English in science is useful to better understand the historical foundation of modern science itself and of its communicative needs (Calaresu 2006). In fact, although it is true that for many centuries European science used a sole language (medieval Latin) it was mostly the advent of modern science itself in the 17th century (with the

important precedent, in some countries, of the protestant reformation) which began to make Latin's power sway and opposed it with a series of future national languages (Italian, French and English etc.) (cf. Altieri Biagi 1990; Rossi 1997). The foresaking of Latin was dictated essentially as a reaction to the power of the Roman Catholic Church and to the traditional scholastic knowledge (which was controlled by the Church by means of the universities), by the emergence of new national (or "micro-national" in Italy and Germany) states which willingly, for more or less noble reasons, sponsored the new science, and also by a new conception of science which was beginning to open up towards the exchange of technical knowledge with the "vile mechanics" who did not speak Latin. In short, so began the procedure which would bring about a more democratic conception of knowledge - conception which arises therefore from the breakdown, not from the promotion, of monolingual knowledge. The voluntary abandonment of Latin did not provoke less international communication among European scholars because they were usually multilingual and, moreover, many printers of that time considered the activity of translating into and from Latin an investment (which also meant that translation costs were not a burden for the scientists, see 4.3).

What this rapid historical summary provides as a useful cue for reflection regarding the current situation is, then, in order: 1) the choice of one or another language in science has never been extraneous to reasons outwith science itself and, on the contrary, has a remarkable symbolic significance in relation to the sociopolitical situation in which the scientist lives; 2) the multilingualism which, with more or less high peaks depending on the discipline, has practically reigned in science in the last 300 years or so, does not seem to have impeded or slowed down either the prodigious advancement of science and technology or the education of the international scientific communities at all; 3) the choice of national languages, in the seat of scientific production, has hardly ever coincided with the scientists' nationalistic seclusion (except perhaps, and only partially, between the first and the second world wars); 4) while the choice of scientists like Galileo and Descartes to use the vulgar languages instead of Latin was actually a free, individual choice, the same cannot be said today of the current, increasing pressure on non-native speaker scientists to publish in English; 5) for a long time the knowledge "industry" and the editorial system facilitated scientists by not making them pay the eventual costs of translating their works (see 4.3); 6) despite the universality which science aspires to and its internationalist *ethos*, scientists' research results and also their careers are conditioned nationally "since the sources of funding for science are overwhelmingly national" (Crawford, Shinn and Sverker 1992: 2).

In short, the history of modern science definitely shows the need for interlinguistic intercomprehension among scholars, but does not show that this is necessarily guaranteed by the convergence on a sole language or that, vice-versa, it is impeded by multilingualism. The reasons for monolingualism or multilingualism in science lies outside matters intrinsic to science itself and derive

rather from historical, socio-political and economic aspects in which the scientific communities have to work.

4.3. Standard English in science. It is frequently stated that international English, as it is not the exclusive "property" of the historically English-speaking community, is adapting to such a role by "loosening" more and more its own norms of use and is breaking up, as already happened with Latin, into many varieties and, perhaps, future new different languages (Crystal 1988: 274). Contrary to this type of general prediction, the breaking-up of English into many varieties is a phenomenon which, at least at the moment, does not concern the international English of scientific communication (especially written communication), but only concerns the so-called 'world-Englishes' in the countries of the ex-British Empire (cf. Brutt-Grifler 2002). The international English of science is still firmly anchored to an Anglo-American standard - and many non-native English-speaking scientists who have become quite competent in this language are often the first to show no liking for a "softening" of that standard, which they consider as adding prestige to their professional *status*. As demonstrated by various quantitative and qualitative data in scientific journals in English (Coates et al. 2002), a "high rejection rate" by the editors is also linked to a faltering use of the English language by non-native authors, while the highest acceptance rate regards native English-speaking authors (see also Ammon 2001a: vii-viii, 2001b: 354). The uses of non-native English in prestigious or learned fields, especially in the case of writing, cannot therefore be compared at all with the more or less informal uses of lay communication to which in fact we refer when we speak of English as the international language of "everyone".

4.4. The costs of multilingualism in science. We frequently hear that the use of a sole international language for science is more "economical" than having more than one language. It is true that even in the most multilingual periods of international science there has always been a quantitative selection of languages and not all national languages have enjoyed the *status* of international languages of science. A scholar, therefore, used to have to dedicate part of his education to learning more languages, but it must be observed that when there are multiple linguistic proposals a scientist can restrict him/herself to achieving reading and comprehension skill in some languages and instead, for his/her production, can select from the most widespread languages of science the one which is most suitable, for example because it is typologically closer to his/her native language. Moreover, if the scientific production of a certain sector is multilingual by nature, all members of the international scientific community have to use some of their own time and of their own material resources for linguistic instruction. When we have a sole language, which is not really a *lingua franca* for everyone, a part of the scientific community does not have to spend time and resources to learn the new languages and that extra time and resources which the others will use to learn and to use the foreign language can be used by native speakers solely for their research activities. With a sole international language the problem of costs is not, therefore,

removed but is simply *shifted* from the entire community to a part of the community. From a strictly economic point of view, in all scientific fields today there reigns a sense of reticence or of shame which means that in works in English by non-native speakers the name of the native person who actually translated the work into English or who carried out a final linguistic revision of the text is usually omitted. As a consequence, it seems that translation and revision costs (both in terms of time and of money) do not even exist. If it were not for this reticence or sense of shame we would have a much less idyllic and egalitarian picture of monolingualism in science than we are willing to admit in public.

5 Contribution of AL

As already mentioned in the previous parts, the problems connected to scientific communication are numerous and can be researched using various approaches and from several points of view. We believe that the privileged, but not exclusive, contribution that AL can provide to scientific communication consists mainly in identifying, developing and propagating a *meta*-awareness of the closely-bound phenomena and problems. When studying "communication" it is precisely *meta*-communication which takes on a decisive role in identifying the ideological schemes underlying the language(s) and their cultural context.

Until now linguistic research on scientific texts has isolated at least two general characteristics: the dialogicity, or interactiveness, and the social identity construction of the researcher within the scientific community in question. This second aspect is today even more important in the face of English as the predominant language in academic communication and the current proliferation of courses on academic discourse in general and on English for academic purposes in particular (also for the non-native speakers, or NNS). The fields of intervention are twofold: a) it must be decided and evaluated which language and which communication tools the novice must acquire in order to become part of the research community; b) detailed research into the relation between language and culture is necessary. Since in the first field a lot of research is already being carried out, we will dwell on the problematic issues of the second, in particular on the relationship between:

1. national language and underlying culture
2. national language and disciplinary culture

Compared with the phenomenon of globalization both issues lend themselves to being investigated with a paradigm of "Linguistic Ecology" and of "Language Planning". In a broader perspective of language policy, it is anything but secondary, as already suggested in 4.4, to take also account of the economic aspects (in terms of both cause and effect) implied by the selection of which and of how many languages are to be used for scientific communication. In the light of the social and practical vocation of AL, it is in fact necessary to pay greater attention to the economic problem and to possible solutions aimed at a more equal

cost distribution within the international scientific community. This could be obtained both by paying more attention to what Ammon (2001a: vii-viii) defines as the "non-native speakers' right to linguistic peculiarities" and also, for example, to proposals of redistribution of publication and translation costs so that these are not a burden only on the individual non-native researchers or only on the non-native scientific communities. This is why we share de Bot's (2004: 65) enthusiasm in welcoming the emergence of 'econolinguistics' as an indispensable field of research for AL "that is concerned with economic aspects of language and language policy". We agree much less with his opinion, which derives from Grin's (see contribution in this Handbook), that "the economic value of English as an additional language is declining because knowledge of English is so widespread that its market value has decreased". This may apply, perhaps, in the case of general or non-specific linguistic knowledge, but it certainly does not apply in the case of writing, especially academic writing, as the widespread "veneration" for the native speaker (NS) requires long-term investments. Graddol (1997) himself says that writing a book in English requires "advanced 'native-speaker' skills" (42). As a matter of fact, as already discussed in 4.3, despite loud proclamations of the existence of "New Englishes", even if a NNS's skills were advanced they would not be sufficient because correctness is still judged on the basis of the NS's canon.

Lastly, in our opinion, there is still not a sufficiently clear awareness of the problems connected to language, culture and ideology. This is the cognitive challenge linked to globalization whose terms are still to be investigated. Does globalization really bring about the homogenization of cultures? What are the real disadvantages of globalization compared to expert knowledge and scientific research? If we substitute *global* with *transnational*, how can/must scientific research aspire to being transnational?

In fact, the strong connection between language and culture is often taken forgranted even though complete proof of this has never been provided. From this point of view language is considered co-extensive of culture, presuming that an indissoluble bond exists between every single language and its specific culture. However, according to van Els (2001): a) every linguistic community, far from having a monolithic culture, shows on the contrary a great wealth of internal variety, at times very distant from each other and showing cultural discrepancies; b) culturally non-marked (i.e., non-specific from a cultural point of view) language can and does exist. Even if he finds evidence of this in numerous directive-informative texts (e.g. in aeroplanes, at railway stations etc.) which are often written in English, van Els (2001: 329) seems however to conclude that, apart from the not infrequent cases of "pragmatic" texts (see above), it is not possible to overlook the cultural references of a language, even when it is a *lingua franca*. Hagège (1992) has a completely different opinion when he states that the historical-natural languages are plural in their cultural and cognitive models and as such are apt to poliphonically express a real world which is multiple by nature.

According to Hagège, attention to heteroglossia is preliminary and fundamental in constructing a form of solidarity whose content goes far beyond propagandist discourses.

One possible way to overcome these two fronts which take forgranted a real world which has still not been sufficiently studied might be to use a different starting point, one which tends to differentiate languages according to diverse degrees of cultural specificness, depending on whether they have undergone historical processes of relative isolation or, on the contrary, of greater aperture to contact and to innovation. In fact, it is by means of contact and of the mechanism of permanent innovation inherent to language that ample portions of culture can be introduced, transferred and adapted to another culture. As already noted by Ammon (2003: 203), we must impose the need to substitute over-generalized and aprioristic evaluations with sound, detailed and empirical analyses to better describe the complex sociolinguistic processes.

Today, generally-speaking, language theory recognizes that permanent innovation is vitally important for the functioning of languages. The diversity and the multiplicity of languages does not belong, therefore, to the pathology but to the physiology of the language. For this reason, even if we had a language "*without space and place*", as post-Empire English could be defined according to Brutt-Griffler's (2005) conception, the greater convergence of the speakers towards a "language with a federative vocation" (Hagège 1992: 124) does not exclude the learning of other languages.

6. Future perspectives on multilingual scientific communication

Leaving aside the reasons (both legitimate) for and against a *lingua franca* for scientific communication, we still have the problem of the imbalance between the scientific communities of native speakers (NS) and non-native speakers (NNS) of English. These notions should be considered according to their prototypical traits and not as discreet categories. Regarding imbalance there are, in theory, two opposite stands: that of the supporters of *laissez-faire* who consider the free market a mechanism of self-regulation and that of the interventionists who aim at measures of rebalancing the trend in progress (Carli 2006). In the *laissez-faire* ideology the language change and shift are considered "natural phenomena" or "natural processes of inexorable transformation" which, as such, avoid any form of intervention whatsoever. However, as a matter of fact, these are not caused by something which is *naturally* inevitable, but by social, economic and political reasons, all induced by human interventions. So, it is more accurate to say that language change is certainly a natural phenomenon in itself but that each of its manifestations is the product of an artifice.

The trend reversal must more realistically be discarded in favour of possible rebalancing measures which reduce the current asymmetries between the English-speaking and the non-English speaking communities. So, when planning

possible language policies, the current common language - namely English - will be incorporated along with some compensatory measures. These have to be studied and formulated on the basis of knowledge ascertained within every linguistic-cultural area and as a function of a global strategy. To obtain a common base it is necessary: a) to carry out a systematic recognition of scientific communication in diamesic and diaphasic dimensions (see section 1) which integrates the current knowledge achieved so far in the almost exclusive sphere of specialized writings; b) to work out proposals of language planning in favour of a real sensitiveness to multilingual linguistic uses for the entire scientific community which includes, of course, also the English-speaking ones.

In the following sections we will briefly point to some important issues which still need further investigation. Considering the multidimensional and multifunctional nature of language dynamics (Mackey 2003: 78), we will therefore discard simplified linguistic models which treat the language and its uses as an indissoluble whole.

6.1. Linguistic ideologies and attitudes within the scientific communities. Both the English-speaking and the non-English speaking communities need to be made more aware of the bond between language and social evaluation, with the aim of achieving a different culture of communication which overcomes the current linguistic prejudices. Attitudes towards non-native linguistic varieties give rise to judgements based mainly on restricting, culturally connotated, models of what is formally correct; this alone often leads to the rejection of the non-native varieties.

6.2. Multilingualism in language comprehension and production. In this type of research the methods of, the time taken and the quality of language learning according to the multilingual or polyglottic dialogue proposed by Posner (1991; but see also Eco 1993: 376-7) need to be further investigated. The feasibility of this proposal offers the advantage of learning the skills of reading and listening in languages different from one's own, at least in those which are closest to one's own language in type and/or territory. In this way, the English-speaking NS would have more chances of filling the gaps in information (not easily found in translations into English) on the historical developments of the discipline which they practise. The advantage, for everyone, would be the possibility of using their own predominant language for producing their work and of using a wider range of non-predominant languages for comprehending others' work. This proposal has so far been rejected and, spoken polyglottic dialogue in particular, declassified as an "unnatural" communication practice. Notoriously, however, when something has not yet been sufficiently tried out and experimented it is often deemed "unnatural".

6.3. Multilingualism and quality of knowledge. The concept of a type of multilingualism which is split up according to the requirements of research activity seems the most suitable way to increase multilingual communication practices for real needs. This makes it necessary for us to note, as already stated in 6.1, the

current state of communication practices as well as the already well-known ones of written communication. Scientific research activities are usually carried out in various phases of communication (invention, definition, revision, discussion, presentation and transmission) both within and without the scientific community in question, and in local, national and international contexts. AL's research hypothesis consists therefore in verifying the quality of the knowledge required for such diversified linguistic uses.

Multilingualism, individual or societal**,** is used a little or a lot depending on the needs and on the values inscribed in the widened cultural context. The reduction of "natural" multilingualism is often the result of a particular communication culture conditioned by ideologies such as, for example, those of the nation-state (May 2001: 5-7). In this case the "natural" linguistic practices, differentiated according to skills and/or to languages/ different linguistic varieties, are impeded by communication habits which correspond to the traditional ideology of the nation-state, also called *nationism*, according to which everything must be carried out in one sole language.

The knowledge and the awareness of what the situation is constitutes the basis for further developments. The first step consists in recognizing that linguistic diversity is desirable and to realize that cognitive diversity is as important for the future of everyone as is the differentiation of the species.

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