# POPULARISING SCIENTIFIC DISCOURSE

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## I. Introduction

Roth, W. M. (2005: 50) considers that:

> Traditionally, the term *scientific discourse* has been used to refer to special purpose language employed by scientists in their laboratories or, perhaps more accurately, in their formal papers, journals, articles, and text books.

This language is explicitly devoid of values, emotions, aesthetics, responsibilities and so on. It allows scientists to talk about genetically modified organisms without engaging in a discussion of long-term effects or individual, collective and environmental health; It allows scientists to develop the atomic bomb and attribute its (mis-) use to politicians. Teaching popularising science similarly focuses on topics presented out of context and without any specific purpose but in the process indoctrinates those students who view science in a particular way. High school students learn about the modification and reproduction of genes but do not simultaneously engage in the ethical debate about the risks of genetic manipulation; students are asked to make interferences about data without being familiar with the data's origin and collection methods.

Science is dependent on the presence and usage of scientific discourse and it is through discourse that professional scientific activities within the laboratory are negotiated, understood, circulated, contested and scientifically evaluated. Professional science aims to use discourse in a communal setting of scientists with in a specific domain and paradigm to find the most plausible explanation of phenomena in the world.

Transitions between ideas are sometimes needed to be clearly expressed using linking expressions since readers could not always infer the semantic relationships. However, such linguistic items contributed to give coherence

and readability to the paragraphs creating a logical flow of sentences. An effective paragraph has to use a structure consisting of a topic sentence to open it, and some subsequent supporting sentence, although the concluding sentence is optional. The topic sentence introduces the main idea of the paragraph and the key words or controlling ideas that will be developed in the following sentences. The supporting sentences constitute the body of the paragraph whose purpose is to make the topic sentence clear and convincing. In order to indicate that the paragraph has reached the end, we find in the concluding sentence the main idea restated.

Metadiscourse interacts within the communication process to expand the scientific discourse. When the scientist personalizes his writing by going beyond the discourse, he uses metadiscourse, which is the linguistic and rhetorical manifestation of an author's presence in a text. The scientific discourse therefore can be seen as the product of the scientist's adaptation to the requirements and his own way of structuring the professional scientific activities. There is a mutual correspondence between belief structure and cognitive genre frame rather than contradiction between them.

## II. SCIENTIFIC DISCOURSE REPRESENTATION

The scientific discourse needs graphic representation, formulas and tables. In the article up the 1980s the researcher does not express himself in his own voice or explicitly through others. In this connection (Gunnarsson, 2009: 54) argues that:

> Evaluation takes the form of the presentation of facts, supported by references to others' works. Summaries of the research of others form an integral part of the description of the illness/method. What characterizes this and other articles in the subcorpus from this period is above all the attitude adapted to facts.

In order to survive in the competitive academic world of medical research, modern scientists adopt pragmatic politeness strategies. Scientists are very careful about expressing the need to emphasize their own achievements, on the one hand, and criticizing those of their peers, on the other. The medical article has developed as a genre due to its homogeneity which indicates a strengthening of genre conventions. The homogeneity is related to the use of headings, the superthematic text structure, and the rhetorical structure of introductions. For the medical discourse community, as for most scientific discourse communities, there is a trend towards a more fact-listing and catalogue type of article that can be seen as an event of stronger discourse community, in the way of a more homogeneous and closed communication.

In relation to the linguistic expressions of evaluations and its variations, the author refers to his own initiatives in most articles, thus (Gunnarsson, 2009: 57) states: "From a diachronic perspective, however, it is more interesting to consider the second aspect, through whom the evaluation is taking place (author's own voice, author through others, author through facts)". Scientific writers address their own group and the medical article genre has become quite esoteric. The popularization of medical findings is undertaken by others- by trained journalists. Scientists can write for their own group without having to worry about a growing gap between the lay public and the experts. The article has become more exclusively internal and less concerned with reaching out to other sectors of society.

III. FORMAL ORGANIZATION OF THE TEXT

Accuracy and precision defines scientific English as Burnham, N. A. *et alii* (2007: 83) state:

> Accuracy is the degree to which a result agrees with the theoretical value. Precision indicates how well that result can be repeated. […]. Both accuracy and precision are useful to know when evaluating experimental results, especially when introducing a new technique or measuring fundamental constants.

The use of section headings has increased dramatically and they relate to its structure: material, methods, results, discussion and conclusions. The modern headings thus structure the presentation in a general scientific way, which also reflects a more homogeneous organization of the texts. When texts are organized in a homogeneous and predictable way, there is less need to elaborate on the details. For readers is easier to know where they will find the different types of content they are looking for in the text.

The number of references per article has increased over time and their presentation has become more homogeneous. With the use of excerpts, we can observe how the account of the research of others has acquired their form, with attributions to articles between brackets instead of explicit references to individual researches. The excerpts show the illnesses described from the perspective of the research. Headings, tables and diagrams are also found in the text. Language and discourse are essential elements in the construction of medical science, in profession- building and in shaping a medical scientific community.

IV. SCIENTIFIC DISCOURSE COMMUNICATION PROCESS

Nowadays the scientific discourse popularisation study is concerned not only how science is communicated to people who do not have expert knowledge in this particular subject, but is more interested in implications for a more general communication process. For example: the disease haemophilia, was initially discussed in medical circles on a scientific basis only in articles in journals. The subject-specific discourse was happening at the same time on two distinct levels: the scientific and the popular genre. Set within the framework of the popularisation of sciences, the present study focuses on how a scientific topic is presented in the written media of the realm of science itself and of the mass communication to lay persons. Brand, C. (2008: 2) stresses:

> Communication at the internal level takes place between experts exclusively within the field. Both the authors and the recipients have received a particular education and gained qualifications in this field so that they are of course familiar with the highly codified medical language and terminology. The scientific corpus compiled for this study consists of a Medical Journal articles written by a medical professional whose objective is to forward clinical results and practical aspects about the disease to their colleagues.
> External communication is intended for lay people.

Aznar, J. A. *et al* (2000: 170) have found that the great advances in recent years in the treatment of hemophilia have produced far-reaching changes in its prognosis. This is mainly attributable to the application of viral–inactivating processes to therapeutic concentrates of coagulant factors of human origin, and the ability of new recombinant products for the treatment of this disease. In addition, the new antiviral therapies for the treatment of acquired immune deficiency syndrome and hepatitis C have enhanced life expectancy.

TABLE 1. The two levels of the hemophilia discourse

| Topic | Level | Audience | Objective | Medium |
|---|---|---|---|---|
| hemophilia | Internal | restricted; medical professionals with special education and knowledge | presentation and discussion of relevant facts | research article or bulletin in medical jounals |
| | External | general: public at large without field specific education and knowledge | popular broadcast of the events, infotainment | new article in papers and magazines |

The hemophilia discourse was then realised at two different parallel levels: the medical scientists' discourse that discussed the disease within the confines of their specialised field, and for the general public related in newspapers and magazines. This double nature can best be described by looking at the different levels of the specific discourse in the table (table 1). External communication is intended for people not having expert knowledge in that subject. The purpose of the articles included in the popular subcorpus is to create awareness and to inform about the topic in television programs that present news and serious subjects in an entertaining way.

The main goal in discourse popularisation is to make scientific in formation accessible to a larger public. This means the choice of language has to vary according to the level of popularization. The aim of popular science journalism is to communicate complex scientific information in a familiar and easily understandable way. This can be reached by reducing the amount of information and by achieving the correct balance between abstract and concrete points. The process of simplification also affects the text itself. C. Brand (2008: 37) implies that: "Producing a popular scientific text basically means recontextualising and first and foremost reformulating the source in such a way that it is comprehensible and relevant to a different kind of audience".

The following skills provide the techniques that are going to be mentioned: To use of substitutional devices instead of the scientific word:

- A term is replaced by a familiar word of vernacular origin (synonym) that has more or less the same meaning. Example: salicylic acid is replaced by aspirin.
- Paraphrasing and reformulating: a term is replaced by a phrase that has more or less the same meaning. Example: Dyspnoea is replaced by difficulty in breathing.
- To provide the definition: the term is replaced by a short description of some specific and general properties. Example: prolactin, which stimulates the mammary gland to produce milk.
- To use a metaphor or an analogy Example: a tumour is like a swelling under your skin.
- The process of generalization: the scientific word is introduced with the help of a statement that expresses an opinion that extends the meaning from an individual to a universal concept. Example: An important feature of some solid tumours is angiogenesis, or the proliferation of blood vessels.
- The process of exemplification and concretization (Brand, 2008: 38): "A term is introduced with the help of one or more propositions that

exemplify the meaning from a general to an individual concept that exists in ordinary life". Example: best-known, and most consumed, methylxanthine is probably caffeine.

A genre change from one state to another from a specific to a general audience requires a reduction in specialization and a rise in comprehensibility.

V. SCIENCE JOURNALISM

The newsworthiness of science is linked to a concrete event rather than the idea of research itself. The public wants to be informed about topics that have immediate practical implications and about possible risks that might affect their lives. Media coverage reflects public concern in so far as it focuses on potential risks, threats and precautions. When it comes to identifying threats, avoiding risks and taking countermeasures, the public take a particularly great interest. Journalists use sensational terms and tend to focus on strategies of influencing information rather than keeping it neutral.

Since scientific journals are the main source of written data in medical discourse, they provide an obvious starting point for the collection of data. The printed version of all major medical journals is available online as downloadable PDF-files. Hence, a selection could be made according to its significance in health up-date, prestige, international circulation as well as reputation in research in a relevant country:

| Medical Journals | Description | Text Types |
| --- | --- | --- |
| **WER** ( Weekly Epidemiological Record) | -Official WHO publication<br>-Published weekly<br>-Important role in health up-date | Bulletins Up-dates |
| **The Lancet** | -International journal<br>-Published bi-weekly<br>-International circulation | -Research Articles |
| **BMJ** (British Medical Journal) | -Journal of the British Medical Association<br>-Published monthly<br>-Prestigious UK journal | -Bulletins<br>-Reports |

| Medical Journals | Description | Text Types |
|---|---|---|
| **CMJA** (Canadian Medical Association Journal) | -Prestigious Canadian medical journal<br>-Published monthly<br>-In English and French language | -Research Articles |
| **JAMA** (Journal of American Medical Association) | -Prestigious U.S. medical journal<br>-Published monthly | -Research Articles |
| **NEJM** (New England Journal of Medicine | -U.S. medical journal<br>-Published monthly<br>Reputation in research | -Research Articles |
| **MMWR** Morbidity and Mortality Weekly Report | -WHO-affiliated journal<br>-Published weekly<br>-Important role in health up-date | -Reports<br>-Bulletins<br>-Up-dates |

Source: C. Brand (2008: 50).

Different journals prefer different types of presentation: primarily research-oriented journals feature research articles, whereas journals that aim rather at informing the medical world about current affairs print shorter reports, bulletins and updates. A "bulletin" is an official statement about something important (e.g. by the WHO); it usually takes up to one page and contains information about emerging diseases and health threats. "Up-dates" are follows-ups of bulletins including the most recent information. "Reports" are articles that are not definitely research-based and provide an overview of a particular topic. However, print media are one of the main sources of information for the broad public and are thus the most important suppliers of news on scientific topics.
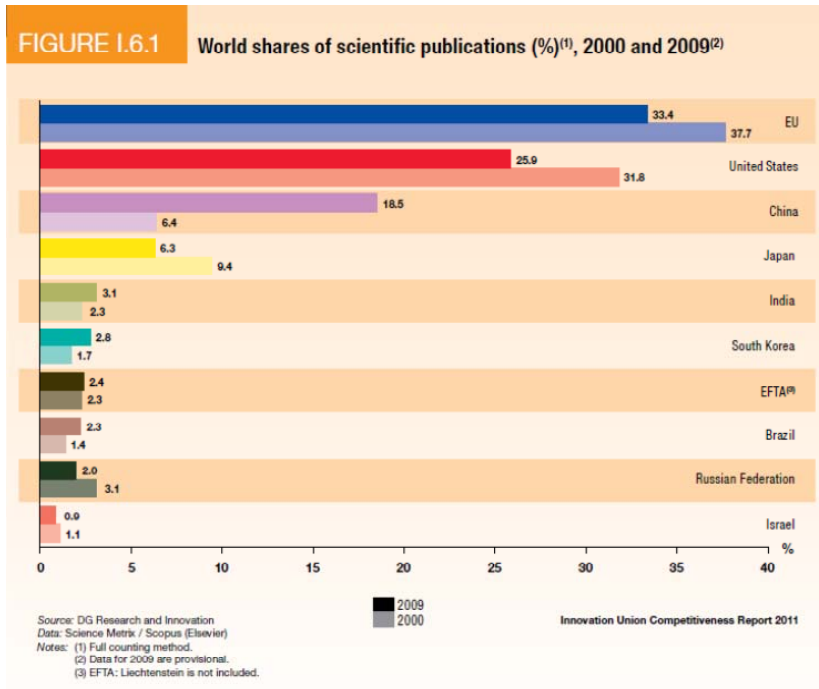
Daily newspaper feature news reports and, if a topic is very important to the public, leading articles. News reports most often include few paragraphs, whereas a leading article can take over 15 pages. Magazines that are published weekly or monthly do not have to operate under the immediate pressure of short-term deadlines and so can provide extensive in-depth reports or even special features on a single topic.

| Newspapers | Description | Text types |
|---|---|---|
| The Guardian & The Observer | Daily quality paper (Sunday - edition is called The Observer -Published in the UK | -News reports -Leading articles |
| Time Magazine & Time Asia Mag. | -Monthly magazine -Published in the U.S.A. for the home market or as an Asian edition | -In-depth reports |
| Sydney Morning Herald | -Daily quality paper -Published in Australia | -News reports -Leading articles |
| Asian Time | -Weekly magazine -Published in Asia | -News reports -Leading articles |
| Newsweek | -Weekly magazine -Published in the U.S.A. | -News reports -Leading articles |
| Washington Post | -Daily quality paper -Published in the U.S.A. | -Leading articles |

Popularising scientific discourse is the meeting point for specific and general language. Hence the table outlined joins the new concept of verticality with lexical patterns in popularising scientific discourse.

| Topic | | |
|---|---|---|
| Scientific discourse | Popularisation | Popular discourse |
| Lexical choice | | |
| Terminology | Institutionalised terms | General words |
| Co-selection | | |
| Priming | Recontextualization | Genre-specific function |
| Genre-specific function | | Priming |

Source: C. Brand (2008: 173).

**FIGURE I.6.1** World shares of scientific publications (%)(1), 2000 and 2009(2)

Source: DG Research and Innovation
Data: Science Metrix / Scopus (Elsevier)
Notes: (1) Full counting method.
(2) Data for 2009 are provisional.
(3) EFTA: Liechtenstein is not included.

Innovation Union Competitiveness Report 2011

Source: (2010: 137) "Outputs and efficiency of science and technology in Europe". *ANALYSIS*, 6. <http://www.scopus.com/home.url>.

A further interesting point is the result of increasing scientific capacity of Asia. China is catching up fast, from 6,4% of world publications in the Scopus database to 18.5% in 2008. The annual real growth of peer-reviewed scientific publication between 2000 and 2008 was 6.9% in the EU, 5.6% in the United States and 28.2% in China (FIGURE 1.6.1).

The European countries with the highest ratio of highly cited publications out of the total number of publications are Denmark, The Netherlands, Belgium, Iceland and Switzerland. EU member states have a low ratio of their publications among the 10% most-cited publications worldwide. However in terms of growth rates between 2000 and 2008 the leading countries are Turkey, Croatia, Estonia, Portugal and Greece.

P. Weeks (1995: 429) highlights:

> The use of science in policy disputes involves two processes relevant to this goal: 1) the state's mobilization of science as legitimising discourse for regulation affects the nature of regulatory science and 2) diverse social groups involved in the policy process problematize alternative construction of uncertain data. Implicit in the first is the dismantling of the science/state dichotomy, creating a new category called regulatory or mandated science. It differs from the idealized version of disinterested, "pure" science in that it has legal, social, and economical aspects.

D. I. Hanauer (2006: 204) acknowledges that popularising scientific discourse in an elementary science classroom is:

> Pedagogical multiliteracy discourse directed at presenting students with established scientific knowledge. […] but this discourse is bound within the inherent power structures of the educational setting in which the teacher's discourse is seen as the conceptual authority.

Thus educational scientific inquiry does not have the authority of professional scientific inquiry and is not able to qualify, to challenge or to add anything new to scientific discourse. As G. Fergurson (2007: 21) concludes:

> The production of high quality scientific research is quite evidently an expensive business, requiring not just an established research infrastructure […] but also the commintment of substantial financial resources on a stable and sustained basis to research, the productivity of whose outcomes may not easily be foreseen.

## VI. METADISCOURSE

Metadiscourse interacts within the communication process to expand scientific discourse. When the scientist personalises his writing by going beyond the discourse, he uses metadiscourse, which is the linguistic and rhetorical manifestation of an author's presence in a text. Recapitulating, a scientist can use various types of metadiscourse for engaging readers, drawing their attention to the act of discoursing and guiding their reading. A. Crismore *et alii* (1990: 226) quote from J. Williams (1985: 119) the definition of metadiscourse:

> Writing about writing, whatever does not refer to the subject matter being addressed. This includes all connecting devices such as *therefore*, *however* and *in the first place*; all comment about the author's attitude: *I believe*, *in my*

*opinion*, *let me also point out*; all comment about the writer's confidence in his following assertion: *most people believe*, *it is widely assumed*; *allegedly*; references to the audience: *as you can see*, *you will find that*, *consider now the problem of*.

Ken Hyland (2009: 3) sets out to give a description of metadiscourse[1]. Metadiscourse means that communication is more than just the exchange of information, goods or services, but involves also the personalities, attitudes and assumptions of those who are communicating. Language is always a means of interaction, expressing verbally the differences between people, and metadiscourse options are the ways we articulate and construct these interactions. This then, is a dynamic view of language as metadiscourse stresses the fact that, as we speak or write, we negotiate with others, making decisions about the kind of effects we are having on our listeners or readers. Metadiscourse thus offers a framework for understanding communication as social engagement. It illuminates some aspects of how we project ourselves into our discourses by signalling our attitude towards both the content and the audience of the text. With the judicious addition of metadiscourse, a writer is able not only to transform what might otherwise be a dry or difficult text into coherent, reader –friendly prose, but also relates it to a given context and convey his or her personality, credibility, audience– sensitivity and relationship to the message.

The idea of an audience is something of a contested notion in discourse studies, but it is generally accepted that a clear sense of who we are writing for or speaking to makes the communicative task easier and increases the chances that the resulting text will successfully meet our goals. This is because an idea of who the audience is gives us a greater understanding of what we can assume our reader/hearer knows and what we need to explain and support. Quoting Hyland (2007: 17): "The notion of *text reflexivity* is particularly interesting as it sees metadiscourse as the explication of the writer's awareness of the text itself, rather than of the reader". Drawing attention to the text represents a writer's goals relative to an assessment of the readers' need for guidance or elaboration. Metadiscourse although not a teaching methodology, has important implications for classroom practice; it provides a knowledge base for EFL students and their teachers and feeds into English for Special Purposes teaching.

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[1] The term *metadiscourse* was coined by Zellig Harris in 1959 to offer a way of understanding language in use, representing a writer's or speaker's attempts to guide a receiver's perception of the text.

7. Conclusion

According to L. Gil Salom (2000: 431): "the discourse of science through the study of rhetorical different types of scientific discourse answer to clearly differentiated aims: the scientific discourse used with academic purposes and the scientific discourse used with career purposes". As Aguilar, M. (2008: 125) further explains: "academic scientists usually write and communicate for a knowledge – transmitting/producing purpose; that is, either they want to initiate students into the knowledge of the community or they want their peers to know and accept their claim(s). Furthermore, they tend to be active members that regularly publish and attend conferences, as a glance at the amount of published research articles in the Science Citation Indexes corroborates. In contrast, professional scientists or technologiss generally write or communicate action-oriented texts such as letters, reports or proposals. When engineers or other technical professionals write internal or external reports, they are not usually constrained by the need to make research space within a discourse community as university members are. The social construction of science is illustrated by four main areas: the writing process, the textual form, the dissemination process and the audience response.

The goal of persuading the audience is said to be already present at this early stage and to play a role in the creation of a scientific claim. Science is not developed objectively and impartially, on the contrary, every writing scientist must interpret the scientific literature while he is experiencing peer pressure to conform to the accepted theories, because the scientist must be able to align his work with that of the leaders. This creates the false impression that science research is monolithic. Scientific literature can be disseminated in two different ways, formally or informally. When formally communicated, it is published in journals; if it is informally communicated, it is disseminated through organised networks of active members who get important information by means of somewhat accidental personal contact, and daily newspapers. Daily newspapers feature news reports and, if a topic is very important to the public, leading articles. News reports most often include few paragraphs, whereas a leading article can take over 15 pages. Magazines that are published weekly or monthly do not have to operate under the pressure short-term deadlines and so can provide extensive in-depth reports or even special features on a single topic. Any scientist when writing seeks a positive audience response and acceptance. But with the passing of time, the initial claim, explicitly accepted through the citation, is no longer cited and is implicitly incorporated into the argument of other scientific texts.

Medical scientific discourse has emerged in a cooperative and competitive struggle among scientists to create the knowledge base of their field, to establish themselves in relation to other scientists and to other professional groups. Quoting C. Brand (2008: 176):

> As far as the coverage of a scientific topic in the newspress is concerned, a process of popularisation has to follow the rules of the genre since the construction of a topic is largely dependent on the genre routines and on the information that is generated from the situation context

Scientific discourse is usually thought to be impersonal. Hence most style manuals encourage academics to use impersonal constructions in order to avoid making explicit their authorial presence in the texts. Notwithstanding, recent research has shown that in scientific writing the choice to announce the writer's presence in the discourse, by means of the use of first person pronouns, is a rhetorical strategy frequently used by scientists to promote and gain accreditation for research claims.

To conclude, I would like to mention the opposite of popularising scientific discourse, the anamnesis (the medical history) of a patient, is information gained by a physician by asking specific questions, either of the patient or of other people who know the person and can give suitable information (in this case, it is sometimes called heteroanamnesis), with the aim of obtaining information useful in formulating a diagnosis and providing medical care to the patient. The medically relevant complaints reported by the patient or others familiar with the patient are referred to as symptoms, in contrast to clinical signs, which are ascertained by direct examination on the part of medical personnel. Most health encounters will result in some form of history being taken. The information obtained in this way, together with clinical examination, enables the physician to form a diagnosis and treatment plan. If a diagnosis cannot be made, a provisional diagnosis may be formulated, and other possibilities (the differential diagnoses) may be added, listed in order of likelihood by convention. The treatment plan may then include further investigations to clarify the diagnosis.

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