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FORMAL STRUCTURE OF SCIENTIFIC JOURNALS AND TYPES OF SCIENTIFIC PAPERS

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RESUM

Les revistes científiques tenen una estructura formal que cal que els qui hi estan en contacte (autors, lectors i editors) comprenguin per tal que els siguin útils. L'autor analitza els tipus d'article que hi ha a tres revistes mèdiques i a una altra d'informació científica general (comunicacions preliminars, articles de revisió, editorials, secció de correspondència) i com s'estructuren els articles de recerca, perquè les altres seccions són de format més lliure.

Paraules clau: revistes científiques / estructura dels articles.

SUMMARY

Scientific journals have a formal structure that has to be understood by all those who read it (authors, readers and editors) in order to be useful. The author analyses different types of articles in three medical journals and one of general science (preliminar communications, review articles, editorials, letters to the editor) and how research articles are structurated, because the other sections have a more free format.

Keywords: scientific journals / article structure.

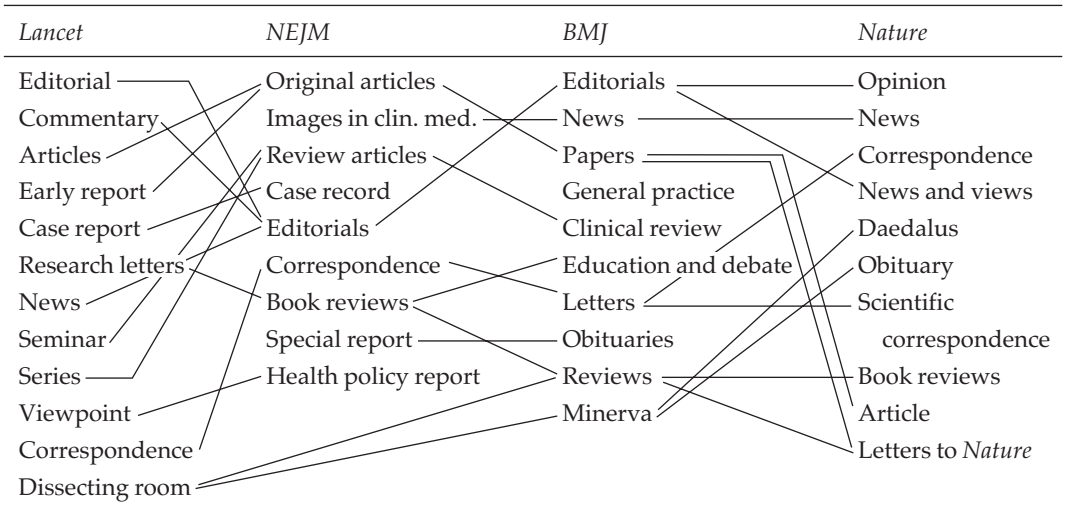
Daily newspapers have a formal structure. If you are interested in sports news, obituaries, overseas news or even the crossword, you know which page to turn to even if there is no index. The learned journals take the indexing of each issue more seriously but the principle is the same. Journals have a formal structure —and within journals papers have a structure too. The regular (and busy) journal reader will find a fixed order of events, both in journals and within research articles, helpful. Moreover, structure provides a template for scientists to write on. Since this *Treballs de la SCB* project is about "spreading science" —a process in which the media (television and radio and newspapers and magazines) have an important role— it is essential for journalists too to understand the structure of academic publications and the differences between types of article.

Of course, science journalists will use many sources apart from science journals themselves. I had the privilege of being invited to give a talk at the Fundación la Marató de TV3 awards ceremony, held at the University of Barcelona on November 17, 1998. The theme was how messages of medical importance —this was a medical ceremony— are diffused from the learned journal to the public via the media. I showed that journals such as *The Lancet* are the basis for only a tiny minority of medical news stories, and the same is true for science generally. But I also argued that more could and should be made of theses sources. [See *Quark*, 1998].

STRUCTURE WITHIN A JOURNAL

It is still possible to find journals that have a simple structure. The simplest would be to have each issue begin with the first page of a research article and end with the last page of a research paper, with no variety in article type in between. The specialist journal *Molecular Medicine* is almost like that: it begins with a description of the history and current work of an individual molecular research institution and ends with a diary of forthcoming meetings, but

TABLE 1. The structure (sections) of three general medical journals and one general science journal.



that is all, apart from the half-dozen research articles in the middle. Many other journals are more ambitious and will include some sort of preliminary communication, review articles, editorials and a correspondence section. The weekly general journals have even more complex structures; they will often include news pages, for example (such pages would seem odd in a monthly or quarterly journal) and they may have editorials of more than one type, so that one or more of them are more like the opinion editorials you would read in a daily newspaper. At another extreme is the purely secondary publication that is only interested in review articles and carries no original research.

Table 1 that summarises the sections found in the weekly science journal *Nature* (*Science* is similar) and three weekly medical journals (*The Lancet*, *British Medical Journal* and *New England Journal of Medicine*). On the surface, it is all rather complicated, which is why I have linked different section headings to show a common purpose even though the section title may differ. Let me simply highlight a few of them by way of examples.

Most of these are regular journal features and they appear in different orders in the four journals, as the connecting lines emphasise.

There is a journal called *Medical Hypothesis*, but the only major general journal in medicine that allows this type of article is *The Lancet*. This is ideally a quantum leap —it is an idea, it must be testable (no point otherwise) albeit still untested, so a Hypothesis article cannot contain results. I have known press reporting of such papers make the mistake of recording the paper as fact rather than theory. Journal referees sometimes misunderstand the purpose too; they tend to be rude about speculation.

Correspondence —letters to the editor that comment (usually criticise) what the journal has published— is a vital section. It is the refereeing process continued in public. Often the exchange is as valuable as the article itself was originally, and this is a neglected tool in the spreading of science.

Commentary/editorial is a device often used by journals to accompany a research article. It may extend the findings by putting them into a wider context, or it may offer a different perspective (e.g. a developing world view or a general practice view) of research coming from an academic hospital setting in the industrialised world. Journalistically, that different viewpoint could be interesting and should not be neglected when the main article has been chosen as a "story".

Review articles are also important to the spreading of science but are usually neglected as sources for the media. Reviews themselves are spreading science because the editor has decided that his readers will benefit from the paper, even though the full details of the research reviewed may not be suitable.

Another danger is the old "fact versus opinion" dichotomy. You would think that journalists were well trained in this but that is not always true. I rather empathize with them. After all, "facts" in journals are not the same things as "truths" and many journalists (and politicians too) find it difficult to deal with uncertainty. In biomedicine —and in public health medicine in particular— the handling of uncertainty is a rare skill.

STRUCTURE WITHIN AN ARTICLE

I am going to focus solely on the classic research paper's structure because other types of article may have no visible structure (e.g. a letter or an editorial). By structure I am referring to labelled sections within a paper; I am not saying that letters or editorials are unstructured writing.

This is the moment to explain SIMRAD —Summary (or abstract), Introduction, Methods, Results And Discussion— the classical format for a research article. Writers, readers and journalists should find this internal structure helpful (and editors do too). It is not perfect. The immunologist and philosopher of science Peter Medawar was a critic; he thought that a rigid structure forced scientists into describing their work in too tidy a fashion. This, he felt, distorted the reality of the way the research idea was conceived and of the way it was explored.

(S) Summaries used to appear at the end of papers; they were short and uninformative. Today they tend to start an article. They are longer, often covertly or overtly structured along the lines of IMRAD, and important because the busy reader may not get beyond them. Moreover, editors know that the Summary is the basis for abstracting services and on-line information providers. Summaries of a different sort are found, for example, in *Nature*: these are non-structured temptations to the busy reader, acting like a chilled *manzanilla* on the appetite.

(I) The background to the study described. What the problem is, e.g. a practical one such as which drug to use for a medical condition, or a more basic one such as the nature of molecular signalling in cytokine synthesis. Ideally, the Introduction ends with a clear statement about the hypothesis to be tested; ideally too, this section does not say what the results are and does not stray chronologically beyond the situation before the study began. These three ideals are often not met.

(M) In clinical medicine this will usually appear as Patients and Methods, although other journals have Materials and Methods; either way, this section is supposed to tell the reader what was done. Some people argue that the detail must be such that anyone else can replicate the research exactly. For example, a biochemical journal will be explicit about the analytical quality and source of the chemical reagents used. Other journals are more pragmatic. For one thing, exact replication may never be attempted — indeed in clinical studies it is usually impossible. Also, the perspective of the journal can differ. A clinical editor will demand a lot of information about the patients. *Nature Medicine* might be worried about the methods, though this journal is not a pure IMRAD practitioner and puts the M at the end.

(R) The big problem for the writer, editor and reader is how much to include in Results. Even with summary tables and illustrations, something has to be omitted and the skills are to include the essential and to avoid repetition by annotating the text where hard data are given in tabular form.

(D) Discussion is the opportunity to interpret the findings reported. What are the strengths and weaknesses of the study; how do its results compare with other research (and, if there are differences, why); and is the original hypothesis supported or refuted, and where next?

CONCLUSION

The first science journals appeared in Europe towards the end of the 17th Century but the big expansion has been in the past 100 years. Before that much scientific knowledge was spread by word of mouth, by personal letter, or by public demonstration and lecture. With a few exceptions, newspapers showed little interest and illiteracy meant that science would not be spread very far even if the media in those days had been involved.

Today, science attracts huge media cov-

erage while for scientists the sources of information have expanded too quickly. Increasingly for the researcher and for the general population the Internet is playing its part. The 21st Century is already witnessing huge changes in the way science is spread, although even if "journals" do not look the way they do now and even if "articles" change too, there will be a need for some sort of structure and some sort of process of selection via peer review and editing.

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