

EDITORIAL

The structure of scientific papers

A few authors respond to reviewers' criticisms and suggestions for redrafting their papers as if their paper was a work of art where altering even a small part of it would destroy its value. Many other authors' responses carry the implicit 'how dare the reviewers criticize work that has taken me such time, effort and considered thought to put together!' Such attitudes are understandable (I have had them myself) because the writing of most papers involves the author in much time and thought and the paper submitted is usually that which the author, or authors, consider is the best account that they can give of their work.

It is fairly common to hear talk about the art of writing scientific papers, and yet I think that we can easily forget that writing a scientific paper is a truly creative act. The best papers combine the science, which forms the basis of the experimental work, and its interpretation with the art of writing the paper in such a way that the paper describes the experimental work accurately, and presents the argument for the authors' interpretation of the results in a way that convinces the reader.

Writing a scientific paper can be considered to involve more creative activity than a work of pure fiction, in that the initial conception of the hypothesis which forms the basis of a research project is a creative act in itself. The preparation of a written proposal to a funding body requires the author both to argue the case for the work and the design of the proposed studies and to present them in a way that is clear and convincing. Frequently the format of such proposals is highly structured to ensure that all the criteria which need to be assessed are clearly distinguishable to facilitate their review. In the more discursive sections of most proposal forms there is, however, albeit limited, space for the author to demonstrate the scientific interest of the work and the intrinsic novelty of the proposed approach and the high probability of advancing knowledge by the work. Such structured presentations may suggest that the preparation of these proposals is a mechanical process with little room for originality, and I often felt that understanding the instructions for completing the proposal correctly was the real test of one's scientific capability.

There has been debate recently in the *Bulletin of the European Association of Science Editors* about whether the formal structure of the traditional scientific paper, the so-called IMRaD structure (introduction, methods, results and discussion), acts as a restriction on authors, or whether the IMRaD structure is the absolute ideal and should be extended to scientific reviews so that the reader could assess the approach and criteria adopted by the reviewer. Some correspondents have suggested to me that our abstracts should also be structured, as adopted by some journals, so that the reader can assess quickly what the paper is about, what was done and the results obtained.

One common feature behind the adoption of formalized structures is that it enables the readers to make quick assessments of specific parts of a proposal, paper, or abstract, without having to read through the whole of the text. Anyone who has sat on a committee reviewing proposals will recognize the benefits of structuring, especially when the committee has to deal with a large number of proposals. Analogously, the structured abstracts are useful for those who wish to scan quickly through a journal. Such approaches are a partial recognition of, and response to, the common complaint about the burden of reading the literature. One radical solution to this problem, and incidentally to the growing

cost of publication, suggested several years ago, was that all published scientific papers should be restricted to one page with the specific details of the methods and results available on request from the authors. Such an approach would relieve the author of developing an hypothesis, and of justifying to their peers their experimental design and the interpretation of their results. It would also create great difficulties for the development of a science and its concepts over time. I believe it also negates the creative nature of scientific writing.

It is quite clear that many of the problems relating to the volume of the literature and to the economics of publishing scientific journals could be lessened by other approaches which would not compromise the integrity of the scientific literature.

First, the emphasis must shift to the quality of an author's published work rather than its quantity (a shift that is just becoming discernible). Second, we must all recognize that the writing of a scientific paper is an art and give more attention to the development of writing skills. I am sure that virtually every paper could be improved by the development of such skills. Third, I think that we need to recognize that the IMRaD structure may not be appropriate for many papers. Choosing the correct structure for a paper will depend very much on the development of writing skills. Finally, I think that we have to accept that much of the current output of scientific work does not justify the permanence of appearing as published text. At the same time much of this output needs to be retained and be accessible to other workers. I believe that there is a real need for archival facilities for much of the bulky methodological details, for example, questionnaires in dietary surveys, and results, such as individual dietary intake data, detailed results of large-scale animal work or nutritional composition studies etc., which nutritional studies generate. These facilities need to be centralized, because authors move on. Ideally the archived material should have some external scrutiny when it is deposited, although the mind boggles at the thought of formal peer review. I think scientific publications are at a critical point in their development. We need to ensure that we retain the best of the well-established tradition of the clear, and closely argued, published paper and use the newer avenues of communication to our advantage, in speed of access and ability to contain large volumes of data in minimal space.

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REFERENCES

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