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Scientific integrity, misconduct in science

Emilio Bossi

President of the Scientific Integrity Committee of the Swiss Academies of Sciences, Berne, Switzerland

Many scientists consider scientific integrity to be a self-evident basic moral attitude. They are of the honest opinion that scientific misconduct is very rare and they also cannot imagine that it could in fact occur in their own institutions. However, this opinion must be considered in the light of international experience in this respect.

There are still many examples of scientific misconduct. Striking examples are taken up by the media, such as the South Korean case of pretended successful cloning of human blastocytes, from which embryonal stem cells were said to have been cultured and which in fact proved to be the result of a hoax [1], or the "proof", from Norway, that antiinflammatory drugs reduce the incidence of cancer of the mouth, which was in fact based on totally fictitious data [2]. Switzerland is also involved. A very special example is the case of a theological ethicist who was accused of plagiarism at the University of Geneva [3]. The US Office of Research Integrity regularly publishes new medical cases in its newsletters [4].

The following text is based on, among other things, the guidelines published by the Swiss Academies of Sciences to provide research institutions, their students and their personnel with an overview of the subject. These guidelines, under the title "Scientific Integrity. Principles and Procedures", were drawn up by a working group of the four scientific academies and published in 2008 [5].

Scientific integrity

Integrity in science is a basic moral attitude. It presupposes ethical reflexion, self-criticism and self-discipline. Responsible practice of research is a basic condition for good research. Should it not exist, the reputation of the research would be seriously impaired and the understanding of new developments and acceptance of innovations would be threatened, as would also be society's willingness to finance research.

Definitions of scientific misconduct

Table 1

Some categories and examples of scientific misconduct.

Misconduct that distorts scientific knowledge, as a result of which society can be put at risk: falsification (incl. deliberate withholding of data); fabrication of nonexistent data.
Misconduct which misleads the scientific community: plagiarism; unjustified authorship; duplicate publication; deliberate false evaluation of projects and results.
Questionable research practices, which cast doubt on the seriousness of the research: sloppy handling of data; division of the results, with publication in several different journals solely for the purpose of increasing the list of publications.

Dishonest behaviour basically constitutes intentional deception, although it may also be the result of carelessness (see table 1). It occurs when nonexistent data are fabricated or when results are falsified, thus distorting scientific knowledge, and possibly putting society at risk. There are other forms of behaviour which are also unacceptable because they mislead the research community, though they do not result in distortion of knowledge. Examples of such incorrect behaviour are plagiarism, unjustified authorship or deliberate false evaluation of projects and results. Questionable research practices constitute a third category of scientific misconduct because they are incompatible with correct research (e.g. sloppy handling of research).

Incidence of scientific misconduct

Due to the inconsistent use of definitions of scientific misconduct, and because of undetected cases or accusations not willingly levelled, no reliable data are available on the incidence of such misconduct. However, a meta-analysis based on 18 published surveys, the comparability of which is acceptable has been carried out [6]. Table 2 provides a brief summary of certain of the results.

Whether these data – which were obtained mainly, but not only, in the USA – can be generalised must remain an open question. For our purposes they had to be checked locally.

Table 2

Incidence of scientific misconduct admitted or observed: meta-analysis of 18 surveys in different scientific disciplines [6].

Percentage of researchers who admitted:		
falsification, fabrication	0.3–4.9%	**mean: 2.6%**
questionable research practices	up to 33.7%	**mean: 9.5%**
Percentage of researchers who had observed scientific misconduct by others:		
falsification, fabrication	5.2–33.3%	**mean: 16.7%**
questionable research practices	6.2–72%	**mean: 28.5%**

Risk factors for scientific misconduct

According to a review of publications dealing with the causes of scientific misconduct [7], there are factors associated with the individual's personality structure, namely narcissism, a feeling of justification (the feeling that one has earned a particular result through hard work), the conviction that one knows the answer to a question in advance, and a distorted sense of reality. External factors also play a considerable role: career pressure ("publish or perish"), insufficient tutoring, poor working climate, interpersonal conflicts, a feeling of being treated unfairly (e.g. in the case of presumed unjustified rejection of grant applications and publications) and the absence of a culture of self-criticism in the research institutions concerned.

Preventive measures

Identification of the above-mentioned predisposing factors provides an important basis for the formulation of measures to prevent scientific misconduct. As far as concerns the criterion "publish or perish", which is often cited as an indictment of academic bodies, it must be borne in mind that the evaluation of a scientific curriculum is essential and that the publication of data constitutes a good basis for this, because publications are in fact the primary media through which researchers account for their work. Naturally there are more intelligent methods of assessing publishing activity than simply counting the number of publications: those who are responsible for the publication and assessment of applications and manuscripts should be aware that the originality of a question, the accuracy of the data, the reliability of the findings and the relevance of the conclusions are of greater value than rapid results and a large number of publications.

Further preventive factors are exemplary behaviour on the part of leading researchers and consideration of the subject "scientific integrity", particularly in informal, but also to a lesser extent in formal, education and training. The observance of so-called "good practices", as they exist mainly for specific fields of research, must be the rule; their strict observance largely prevents scientific misconduct. For general rules, see [8].

Preconditions for the responsible practice of research

Responsible research requires respect for the limitations of freedom of research, as well as veracity, openness within the research group and dialogue with the scientific community and the general public.

In the course of a research project, responsible scientific conduct is supported by observance of the following points:

In the *planning phase* the feasibility of the research plan must be checked, so that later no one will be tempted to distort data in order to complete the project. The roles of the individuals involved must be clearly defined, to avoid interpersonal conflicts. The right of authorship and the order in which the various authors are listed in publications must be clarified at as early a stage as possible (the most frequent problems faced by the ombudsman of the academies are disputes concerning authorship!). The financing of projects and the sources of finance must be clearly stated. Conflicts of interest must be presented honestly and transparently; if such conflicts exist, even a faultless project can lose its entire value. The handling of data and materials must also be clearly defined: who can be informed of the results in the course of a project, and when? Agreements between researchers and sponsors, other research groups and other instances must be documented. A model for such an agreement in the framework of international collaboration has been proposed by a working group of the OECD; see [9].

In the course of the *execution of a project* the procedure must be accurately and reliably documented. Data and materials must be stored in such a way that they cannot be lost or manipulated. There must be an open exchange of information within the research group (beware of colleagues who try to gain personal advantage by concealing information!). After publication of the results, external researchers who are interested in reproducing a project or parts of it must be given appropriate assistance.

Publication of the results of the research must be unbiased and complete: the deliberate withholding of data is considered a falsification. Presentation of the results in separate publications for the purpose of increasing the number of titles published is to be avoided.

Procedure where scientific misconduct is suspected

The academies strongly recommend that all research and research-promoting institutions should adhere to clear rules and nominate a contact person who is responsible for protecting scientific integrity. Smaller institutions may consider whether they wish to do this together or join an existing organisation. If no such organisation exists, experience teaches us that any unprepared reaction to suspected scientific misconduct is always likely to go wrong; in most cases it will be incorrect and inappropriate and thus discredit the institution and science as a whole.

The academies have suggested a model of how such an integrity organisation could be structured [5]. This is presented here only in abbreviated form. According to this model, the institution should appoint an ombudsman and a person with responsibility for investigational procedures (who might be called "integrity commissioner") for a fixed period of office. If scientific misconduct is suspected, and if on the basis of an initial evaluation the ombudsman considers the allegation to be valid and well-founded, and if he/she considers that an appropriate procedure should be initiated, then the case is referred to the aforementioned integrity commissioner, who will appoint a fact-finding panel of specialists in the specific field with responsibility for the particular case. The academies are of the opinion that both internal and external persons should be members of this fact-finding panel or at least be included as experts. The internal panelists should be included because of their knowledge of the local situation, and the external ones for their broader view of the situation and to facilitate acceptance of the final decision. The fact-finding panel provides the necessary clarifications. If it finds that scientific misconduct has occurred, the research institution appoints a decision-making panel which will make the final decision on the basis of the fact-finding panel's findings. If this panel also comes to the conclusion that misconduct is evident, it informs the higher institution (e.g. the university) of this and justifies the allegation. The management of this higher institution will then draw the necessary conclusions and order appropriate measures.

This procedure must meet the following basic requirements: hearing of the individual accused; confidentiality for all persons involved in the procedure (complete confidentiality is difficult to achieve, but it must be as complete as possible); protection of the person making the allegation (whistleblower protection, which is also a delicate task that nevertheless must always be taken seriously); any persons who may be biased must not be involved in the procedure; the individual procedural steps must be documented in writing, with the possibility of appeal.

For most researchers responsible scientific conduct is self-evident. For the well-being of sci-

ence and society in general it is necessary to keep the number of cases of scientific misconduct as low as possible. This requires formal handling of the matter by organisations such as the Swiss Academies of Sciences, as well as a more informal promotion of awareness of the problem in everyday research by the research institutions themselves. To make scientific integrity a science in itself is certainly not the objective. However, heightening awareness of this particular subject is one of the aims, and is in fact the purpose of this article.

Correspondence:
Prof. Emilio Bossi
Eggweg 54
CH-3065 Bolligen
E-Mail: emilio.bossi@meddek.unibe.ch

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