The ethics of collaborative authorship

More realistic standards and better accountability are needed to enhance scientific publication and give credit where it is due

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The competition to publish research in top-level, international journals is made ever harder by the ongoing, exponential generation of knowledge in the life sciences. But increasing competition is not the only hurdle that scientists must leap in order to publish their research. Many also face the combined challenge of the English language and the particular style of scientific writing that is required by peer-reviewed journals. Fluency in English and good writing skills are therefore essential for success in scientific research.

Research in the life sciences is increasingly collaborative, both at the national and international levels. This can help to alleviate the problem of language barriers; yet, collaborating with a native speaker for the explicit purpose of writing a manuscript raises new ethical challenges, in particular in regard to what constitutes authorship. In this article, I explore what constitutes authorship in a scientific context, and consider how international writing collaborations could solve the problem of publishing successfully as a non-native speaker without falling foul of ethical hurdles. Such writing partnerships could become a legitimate form of research collaboration, as long as strict, well-defined rules of authorship and publishing are agreed and adhered to.

The most basic form of scientific collaboration (Sidebar A) is a research team in which scientists have separate or overlapping tasks and in which a supervisor or primary investigator defines the goals. To an increasing extent, collaboration, partnership and cooperation (CPC) involves local, national and international partners within private and government research institutes that contribute specific

knowledge, expertise, material or equipment within the framework of a national or international project. Larger CPCs allow teams to tackle complex research goals more efficiently. Economically developed countries are also increasingly entering international CPCs with developing countries (Royal Society, 2011).

There is a clear trend in science towards international CPCs; the number of international collaborations trebled between 1990 and 2005 (Leydesdorff & Wagner, 2008). Whereas there were about 50,000 internationally co-authored articles in 1990, this number increased to about 150,000 in 2005—a threefold increase over a 15-year period. This came with a fourfold increase in the number of international addresses on publications—which rose from 150,000 in 1990 to more than

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600,000 in 2005 (Leydesdorff & Wagner, 2008). As a result of increasing cooperation across borders, the number of internationally co-authored articles is growing at a faster rate than 'nationally co-authored' articles (NSB, 2002); the former are also cited more often (Royal Society, 2011). The same authors also identify a core group of the 14 most cooperative countries (Table 1; Leydesdorff & Wagner, 2008).

Regardless of their size or type, all scientific CPCs have the ultimate goal of publishing their results in a peer-reviewed journal. However, not every scientist is a good writer. It often takes years to acquire the linguistic and stylistic skills and experience required to draft a manuscript for a leading journal, and even native English speakers can struggle. Thus, a partnership with one or several scientists who

Sidebar A | Collaboration, partnership and cooperation

Collaboration can be broadly defined as a process in which two or more parties—individuals or institutions—work together to achieve a common goal. Each party might have a different *modus operandi*, but usually all parties share the same values or ideologies. Knowledge is usually shared through open discussion and there is generally a 'leader' of the collaboration, although this is not a *sine qua non* to success. In science, we can define three ways in which partners can work together to realize a common purpose or goal:

- (i) Collaboration is a recursive process that can fundamentally change the approach of the individual partners to achieving the goal.
- (ii) A partnership is a formal arrangement among entities and/or individuals to advance their interests.
- (iii) In cooperation, the individual partners maintain their separate activities and interests, but join forces temporarily to meet a common goal.

All three forms of working together, referred to as collaboration, partnership and cooperation (CPC), can help to level the playing field in science by allowing weaker actors to join high-level research if they have something to contribute (Teixeira da Silva, 2011a).

Table 1 | Rank in the percentage of CPCs

1990		2000		2005	
USA	27.8	France	20.5	France	31.0
France	25.2	USA	15.3	Russia	9.6
England	12.6	England	14.8	UK	7.8
Australia	5.0	Russia	6.1	Sudan	7.4
South Africa	4.4	Germany	5.3	Colombia	6.4
Canada	4.0	Australia	4.1	Namibia	6.2
Egypt	3.8	Denmark	3.9	Germany	6.2
Germany	3.4	Canada	3.5	USA	5.9
Sweden	3.1	Malaysia	3.3	Senegal	5.7
Belgium	2.9	India	3.2	Cameroon	5.0

Ranks are shown after cosine transformation. Source: Leydesdorff & Wagner (2008). CPC, collaboration, partnership and cooperation.

Fig 1 | Contribution (percentage) of corresponding authors in major medical journals. The original manuscript does not indicate if any one author assumes more than one function. Source: Baerlocher *et al* (2007).

...a partnership with one or several scientists who provide support for writing and editing could greatly increase the chances that a manuscript is accepted

provide support for writing and editing could greatly increase the chances that a manuscript is accepted (Teixeira da Silva, 2011b). As Bahr & Zemon (2000) state, "in the sciences [...] collaboration encourages author productivity and enhances article quality. As research becomes more quantitative, collaboration increases." Investment in science CPCs, including writing CPCs, should pay off in terms of prominence and reputation, economic returns or international networks.

However, there has been no detailed analysis of the ethical aspects of scientific writing CPCs; most of the information available is fragmented, as the ethical guidelines provided by individual publishers or on websites, wikis or blogs are inconsistent. In fact, nearly all aspects of defining authorship are regulated by individual journal guidelines and customs rather than agreed principles, despite their importance in scientific publishing. Consequently, authorship practices vary substantially, often reflecting cultural differences (Suhr, 2009).

An author is the creator of a unique literary or artistic work, the originality of which is protected under intellectual property laws, such as copyright in the USA or authors' rights in the European Union. In science, authorship is also central to the responsible

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conduct of research, as all authors take full responsibility for their results and the interpretation thereof (RREE, 2011). In the context of writing CPCs, however, genuine authorship is not solitary and individual, but is a collaborative and group-oriented exercise. Scientific papers need to have several authors in order to give credit to all the people involved in a project, including those who did not actually write the manuscript, but still conducted the bulk of the research (Woodmansee & Jaszi, 2003). Having several authors is therefore different to radical collaboration, of which Wikipedia is an example, in which everybody writes the article together. Still, some of the values of radical collaboration apply to science: "...the nature of collaborations is variable, but responsible collaborations are always defined by openness and early, on-going communication. Science is a communal enterprise; both science and society are best served by collegiality and open collaboration. There should be a mutual understanding of what is to be exchanged through the collaboration, how the research will be undertaken, and how the products of the collaboration will be shared. Collaboration is most likely to succeed if expectations are clearly communicated (and perhaps documented) before commitments are made" (RREE, 2011). Nevertheless, this does not mean that every collaborator is also an author of the manuscript *in sensu strictu*; in reality, a few people do most of the writing and editing. This therefore raises the question of what is an author in scientific publishing.

Many, if not most, biomedical journals have adopted the definition of authorship from the Uniform Requirements for Manuscripts Submitted to Biomedical Journals, published by the International Committee of Medical Journal Editors (ICMJE; <http://www.icmje.org>; ICMJE, 2006). So have many publishers and other organizations, including the Committee on Publication Ethics (COPE; <http://publicationethics.org>), the World Association of Medical Editors (WAME; <http://wame.org>), the

Council of Science Editors (CSE; <http://www.councilscienceeditors.org>) and Elsevier (<http://www.elsevier.com/wps/find/editorshome.editors/Introduction>).

According to the ICMJE definition, someone is an author if and only if he or she has done all of the following: “1) made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafted the article or revised it critically for important intellectual content; 3) approved of the final version to be published.” In practical terms, however, it is becoming increasingly difficult for any one researcher or supervisor to assume all three responsibilities, as research teams usually divide their labour to optimize time and resources.

The ICMJE definition goes further, “Acquisition of funding, collection of data, or general supervision of the research group alone does not constitute authorship.” Although this definition is a valuable guide because of its specificity, it is at odds with both common practice and other views of authorship (Yank & Rennie, 1999). The *Journal of Investigative Medicine*, for example, analysed the contributions of authors in medical journals and found that only a small percentage fulfilled all of the requirements of the ICMJE definition (Baerlocher *et al* 2007; Fig 1). Instead, each author assumed one or more roles or responsibilities within the context of the research project, but never—or extremely rarely—all three. Of direct relevance to this discussion is the finding that around 75% of authorships were attributed to one of the co-authors who had drafted the manuscript, and about 65% of authorships were attributed for editing.

...authorship is also central to the responsible conduct of research, as all authors take full responsibility for their results and the interpretation thereof

The reality is that the application of the guidelines of the ICMJE would probably invalidate most of the research published in biomedical journals, because only a minority of authors individually fulfil all of the criteria. Strict application of the guidelines would also create another problem; authors often sign licenses with publishers stating that they will abide by the publisher's guidelines, which often include observance of the ICMJE ethical standards. Authorship

Publishing research—a collaborative effort.

not in line with the ICMJE guidelines would therefore invalidate the license.

To eliminate possible discord, I therefore propose that it should be the members of a CPC who determine who has contributed to ‘authorship’. As it is impossible for a journal or publisher to verify the contribution of any author to a research paper, this is the *de facto* reality in any case. However, this declaration of authorship should be made more formal and more detailed than is currently the standard. Provided that each author fulfils at least one of the main ICMJE clauses, their contribution should be sufficient to warrant ‘authorship’, in my view.

One alternative is the ‘contributorship’ model that has been adopted by many journals—for example, all Biomed Central journals. This model requires contributors to a paper to declare their exact or ‘explicit’ contribution and tends to be more flexible than the ICMJE definition of authorship (RREE, 2011). However, although it provides more openness, it does not indicate whether each author deserves to be an author, and therefore does not address the ethical issues of CPCs. The contributorship model is similar to the Quantitative Uniform Authorship Declaration (QUAD) system, in which authors are listed in descending order of total contributions across four categories: conception and design, data collection, data analysis and

conclusions, and manuscript preparation (Verhagen *et al*, 2003). An author should contribute at least 10% to any one category, although QUAD does not provide practical means of quantifying the contribution of a single participant.

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Ultimately, no matter what the definition of authorship is (Table 2)—whether with or without signed declarations—there is still no way for journals, publishers or the public to confirm the contribution of each author, or to assess whether the nature of the contribution is ‘substantial’ or ‘significant’, or, indeed, ethical. Unlike statistical analyses, in which the term ‘significant’ refers to a confidence interval, the term as it is used in ethical guidelines does not have the same meaning. Responsibility cannot be clearly quantified, weighed or measured and is therefore subject to individual and subjective interpretation by authors, editors, reviewers and publishers.

Authorship, as defined by leading biomedical bodies and publishers, has undeniably different interpretations and nuances. Although most prerequisites for authorship are logical, and although

Table 2 | The standards of authorship set out by various publishers and organizations

Publisher/ organization	Standard of authorship	Comments
American Chemical Society	Authors “share responsibility and accountability for the results.” (www.acs.org)	No further details are provided.
American Psychological Association	Authorship must include those who have made substantial contributions to a study such as “formulating the problem or hypothesis, structuring the experimental design, organizing and conducting the statistical analysis, interpreting the results, or writing a major portion of the paper.” (http://www.apa.org/ethics/code/index.aspx)	Although these guidelines list many other forms of contributions to a study that do not constitute authorship, they state that combinations of these and other tasks might justify authorship. It also considers institutional positions, such as Department Chair, insufficient for authorship.
Annals of Internal Medicine	“Authors should meet all of the following criteria, thereby allowing persons named as authors to accept public responsibility for the content of the paper: 1) Conceived and planned the work that led to the article or played an important role in interpreting the results, or both. 2) Wrote the paper and/or made substantive suggestions for revision. 3) Approved the final version.” (http://annals.org/site/misc/ifora.xhtml)	As for the ICMJE, all of these conditions must be met, although there is room for interpreting the responsibilities of each author under condition 1.
British Sociological Association	“Everyone who is listed as an author should have made a substantial direct academic contribution (that is, intellectual responsibility and substantive work) to at least two of the four main components of a typical scientific project or paper: a) conception or design; b) data collection and processing; c) analysis and interpretation of the data; d) writing substantial sections of the paper (for example, synthesising findings in the literature review or the findings/results section).” (http://www.britisoc.co.uk/Library/authorship_01.pdf)	—
Elsevier	“Authorship should be limited to those who have made a significant contribution to the conception, design, execution, or interpretation of the reported study. All those who have made significant contributions should be listed as co-authors. Where there are others who have participated in certain substantive aspects of the research project, they should be acknowledged or listed as contributors.” (www.elsevier.com/ethicalguidelines)	Elsevier is more realistic than the ICMJE, as it only requires authors to fulfil one of the roles listed—it uses the language of ‘or’, rather than ‘and’. Ironically, many Elsevier journals follow the ICMJE guidelines.
ICMJE	Someone is an author if and only if he or she has done all of the following: “1) made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafted the article or revised it critically for important intellectual content; 3) approved of the final version to be published. Acquisition of funding, collection of data, or general supervision of the research group alone does not constitute authorship.” (ICMJE, 2006)	—
Proceedings of the National Academy of Sciences of the USA	“Authorship should be limited to those who have contributed substantially to the work. The corresponding author must have obtained permission from all authors for the submission of each version of the paper and for any change in authorship. All collaborators share some degree of responsibility for any paper they co-author. Some co-authors have responsibility for the entire paper as an accurate, verifiable report of the research. These include co-authors who are accountable for the integrity of the data reported in the paper, carry out the analysis, write the manuscript, present major findings at conferences, or provide scientific leadership to junior colleagues. Co-authors who make specific, limited contributions to a paper are responsible for their contributions but may have only limited responsibility for other results.” (http://www.pnas.org/site/misc/iforc.shtml#ii)	This model and interpretation of co-authorship seems amenable to the idea of international writing CPCs, as it assumes that each author need not fulfil all of the criteria. However, it is vague in terms of what contributions constitutes authorship.
US National Academies and Online Ethics Center	“An author who is willing to take credit for a paper must also bear responsibility for its contents. Thus, unless a footnote or the text of the paper explicitly assigns responsibility for different parts of the paper to different authors, the authors whose names appear on a paper must share responsibility for all of it.” (http://www.nationalacademies.org/ ; http://www.onlineethics.org)	This is far more realistic than the ICMJE model, as each CPC member would need to assume collective responsibility for a research project and its published paper.

there is general agreement as to their universality, there are still divergent issues and poor definitions, such as the use of ‘and’ by the ICMJE’s compared with the use of ‘or’ by Elsevier (Table 2). Such apparent contradictions, in words and definitions, create confusion among authors and scientists as to whether or for what a person can be considered an author.

I propose a broader term for biomedical research that defines collaboration at several levels—the CPC. It would allow authors to assume not only intellectual recognition for their role and participation in the research or in the final manuscript, but also collective responsibility for all aspects of the project from conception to completion, even if their individual role was

limited. Since the final product of a research project is the paper, the person who is responsible for the writing and editing of the manuscript deserves authorship for the simple reason that such an effort would be necessary to guarantee publication.

There are four possible solutions that, combined, might solve the problems surrounding authorship: detailed and publicly

Responsibility cannot be clearly quantified, weighed or measured and is therefore subject to individual and subjective interpretation either by authors, editors, reviewers or publishers

available ethical guidelines for each research institution related to research and its publication; a system that can better quantify the participation of an author, and thus their position in a manuscript byline; new authorship guidelines that serve both the publishing and the scientific community; and global rules on research and writing CPCs together with local ethical guidelines to address culture-specific issues. For example, on the Indian sub-continent—India, Bangladesh, Pakistan—it is common to add the head of department or faculty to the byline, even if they fulfil none of the criteria of authorship. Similarly, senior laboratory members are often assigned authorship in south-east Asian countries regardless of their real contribution; in Japan, most PhD students have two or three advisors who, in many cases, automatically gain co-authorship of any paper emerging from the PhD thesis. This is a cultural ‘gesture of appreciation’, and it is ethically acceptable in these countries. As this violates most definitions of authorship (Table 2), many journals will ask authors to remove such names from the paper. The fact that their definitions clash with cultural requirements or traditions shows how difficult it is for a publisher or editor to define true contributorship.

Scientific research is a dynamic enterprise that is constantly evolving to adapt to new challenges, possibilities and technological advances. Most prominently, the number and size of collaborations across research institutions and borders are increasing to tackle increasingly large and complex research projects. The attribution of authorship and the ethical implications that come with publishing results from large research teams should be adapted accordingly.

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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