

any part of a published work.

Note: References 3 and 4 are used to illustrate the issues analysed in this comment, in order for readers to understand the context of this discussion. There are several such examples in the public domain and the author has no intention of defaming the research undertaken by these and other researchers in large group studies.

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COMMENT

Attribution and credit bias in publication ethics

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Abstract

In this article, I argue that many of the ethical problems associated with the authorship of journal literature can usefully be clarified if authorship is placed within the broader concept of attribution, which extends beyond the author byline to encompass everything that readers are told about the work's origination and the parties responsible. I also suggest that as the attribution of literature has grown more complex, and the opportunities for misattribution have become more subtle and multifarious, attribution has become increasingly vulnerable to systematic bias. Accordingly, I define "credit bias" as the systematic distortion of attribution, frequently in the interests of those with influence over the publication. I present a four-step framework for evaluating publications, discuss misattribution in drug industry literature as an illustration of credit bias, and examine the role of editorial standards in mitigating, but also in assisting, credit bias. I also argue for an independent scientific standard to promote ethical conduct in the medical journal sector.

Keywords: attribution, authorship, contributorship, bias, publications, journals, ICMJE, CRediT

The ethics of authorship can be clarified in useful respects by considering the problem in terms of the broader *attribution* of intellectual content. The attribution of an article includes its authorship, but extends beyond the author byline to encompass everything that readers are told about the work's origination and the parties responsible. As I discuss below, some of the well-known ethical difficulties attending authorship, including ghostwriting and guest authorship, are better understood as manipulations of attribution rather than of authorship alone. I discuss the nature of attribution and argue that as the scope for misattribution has become subtler and more complex, it has become useful to think of attribution as being vulnerable to systematic bias. I refer to this form of bias herein as "credit bias". I also discuss the longstanding attempts by journal editors, bibliographers and others to improve the attribution of medical literature, and the implications of these measures for bias. My goal is to establish both attribution and credit bias as standard concepts in publication ethics and within the study of bias.

A simple stepwise framework for examining published content involves four stages [Table 1]. The first step is to clarify the publication's *setting* and *context* — that is, the location and format of the material that will be authored, its agenda and relationships to other content, and the standpoint from which it will be investigated. Here, I focus on medical journals. The second step is to examine the *stakeholders and contributors* — that is, everyone who

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Table 1. Four-step framework for evaluating journal articles

	Definition	Examples	Example questions
1. Setting, context, perspective	The <i>location</i> where the content is published, and its characteristics. The <i>relationships</i> of the publication to other publications, communications and activities. The <i>context</i> of the article and the <i>perspective</i> taken by the researcher evaluating the article.	<i>Location:</i> journal, supplement, online material. <i>Relationships:</i> article is one of a series, or part of a publication plan, or linked to non-journal activities. <i>Article's context</i> and <i>researcher's perspective:</i> eg with respect to research controversies, commercial agenda, legal issues etc.	What is the standing and status of the setting? Who are the intended and actual audience? How might the setting influence readers? Is the article part of a PR or marketing campaign? Does it promote a specific product or idea?
2. Stakeholders and contributors	Every individual, collective entity and company who has an <i>interest</i> in the article or the research it describes, or who <i>contributes to its development</i> .	Byline authors and their institutions. Corporate authors, e.g. pharmaceutical companies. Journals, their editors and proprietors. Trial participants. Readers and patients.	Who are the most powerful and influential stakeholders? Whose interests are served by the publication, and what biases might this lead to?
3. Content	The full <i>content</i> of the article, the <i>data</i> on which is based, and the <i>process</i> by which the study was conducted and the manuscript crafted and finalized.	Scientific question; Experimental design; Trial conduct; Data analysis; Data availability; Results reported; Interpretation of results; Style and Rhetoric; Parties responsible for each step.	Is the content reasonable, meaningful well designed and objectively reported? Are the data available to independent scrutiny? What biases are present? What important questions cannot be answered from the content as presented?
4. Attribution	Everything that is conveyed to the reader about the origin and development of the content, including the <i>names</i> of all parties involved, their <i>roles</i> and <i>motives</i> . Clarity, salience, conspicuity and reader perception are all aspects of attribution.	Author selection, Author order, contributor listings, author disclosures, acknowledgements, contributor listings, descriptions of commercial parties and roles, use of corporate authorship, use of title, labeling.	Does the attribution faithfully highlight the parties primarily responsible for the content? Is the role of any parties downgraded, obfuscated or omitted? What functions might the attribution serve other than listing the authors and other contributors?

contributes to or has an interest in the publication of the material at hand. Research scientists and doctors, including listed authors and contributors, as well as funders and corporations, journal editors, journal proprietors, readers and patients might all be considered stakeholders and/or contributors in this setting. The third and most complex component is *content* — by which I mean the content of the material under discussion, and the means by which that content is determined and produced. In medical journal literature, this refers to the research itself, to its conception, design, conduct, data collection, documentation, analysis, interpretation, and then finally, reporting and communication. Nearly all recognised forms of bias in scientific medicine relate to the production and presentation of intellectual content.

Attribution

But it is the fourth and final step of this analysis, attribution, which interests me in this article. *Attribution* is everything that is conveyed to the reader about the origins and development of the work, including all the parties involved, what they did and what their motives were [1, 2]. Attribution confers credit upon contributors and provides an enduring record of who did what, thereby helping keep the books of accountability, but it is also a form of labelling that draws readers' attention to

key aspects of the article's origination. A well-attributed article is comprehensive in its record-keeping, but also highlights to the reader what is most salient about the origination of the material and the parties responsible. By contrast, a poorly-attributed article is less than comprehensive in its documentation, and downplays, obfuscates, misrepresents or omits important information. In the traditional model of independent science, in which research is conceived, conducted and reported by one or a small group of scientists, attribution consists simply of the author byline; but in much contemporary research involving larger and more complex research groups, or in which industry is involved, attribution has become more complex. The notion of "credit bias" — that is, the systematic distortion of attribution such that it does not provide a full and accurate description of the parties responsible for the work and their roles — has become increasingly relevant as journals have sought to provide *more* information about the content they present to readers — indeed, it is perhaps a general principle that the more detailed and complex the information to be communicated, the greater the opportunities for the encroachment of bias.

Our current understanding of attribution is far from complete, and indeed even the term "attribution" is little

used at present in publication ethics. There are two main sources for the insight that we have into attribution. The first of these is the work of journal editors and more recently library and information scientists, who have sought to capture and classify the many types and degrees of contribution to medical and scientific literature. With respect to journal editorial policy, important proposals for widening attribution beyond authorship were made by Mouloupoulos et al, Fotion and Conrad, Resnik, and Smith among others [3-6], but the most influential work was that of Rennie and colleagues on the notion of *contributorship* [7,8]. Their original proposal was that authorship should be replaced by notes detailing what everyone involved in the study did; in the event, authorship has been retained by journals, and contributor listings tend only to list authors' contributions and not those of non-authors. With respect to bibliography, the Contributor Roles Taxonomy (CRediT) and associated initiatives are currently seeking to establish a standardised classification of contributor roles [9-12]. I consider these initiatives below:

The second major source of our understanding of attribution in the journal setting has been studies of pharmaceutical marketing practices within medical journal literature, such as guest authorship and ghostwriting [see for example 2, 13-15]. By studying commercial practices, it has been possible to gain a fuller understanding both of the functions of attribution and of the techniques by which these functions are exercised. It is clear on the basis of these studies that attribution not only serves documentary purposes, but also involves an interaction with readers, whose *perception* of the article's provenance and credibility can potentially be managed [2]. This psychological aspect of the attribution of academic literature has neither been adequately studied by scholars, nor properly understood by journal editors, whose policies frequently fail to recognise that lauded concepts such as "disclosure" and "transparency" are blunted, and may even become means of concealment, if key facts about an article's origins are shrunk to the margins, like onerous clauses hidden in the fine print of a contract.

The number of attributional devices used in medical journal literature today is remarkably broad. If we consider a typical clinical trial report in a leading medical journal, the most important and prominent form of attribution is of course the author byline. Authorship remains the most prominent and prestigious form of attribution, and at present is the only one to be bibliographically documented. But the full range of attributional devices that can be used is much wider [2, 16]. There is the *number of authors* among whom credit is shared, and the *order* in which they are arranged and their chosen *affiliations* listed. There is the choice of *corresponding author*. There is the *acknowledgements* section, describing the roles of non-authors, such as ghostwriters, marketing agencies, clinical research organisations, academic colleagues and functionaries. There is the acknowledgment of *funding*. There is the *contributor listing*, as described above. There may be a *text passage* in the Methodology section or footnotes describing the "role of the funding source". Author *declarations* may cite individual grants which helped bankroll their

participation in work, and disclose financial interests. There is an option to name *corporate entities* in the author byline or in the *title* of the article, and academic research groups are not infrequently attributed in this way. Journals also have the option to add advisory information for readers to articles they publish, although this is seldom exercised. All these many forms of communication with readers are part of the article's overall attribution. Furthermore, what the article *highlights* about its origination, with prominent display and clear language, and what it downplays, through unobtrusive display, vague language and omission, all have a bearing on the overall attribution of the piece, since they determine what is likely to be perceived or overlooked.

Credit bias

The clearest definition of bias remains that of David Sackett, who described it as "any process at any stage of inference which tends to produce results or conclusions that differ systematically from the truth" [17]. Many biases are entirely inadvertent, emerging for example from unintended flaws in a study's design; others serve the interests of stakeholders and participants, and stabilise according to the forces in play, like iron filings aligning in a magnetic field; these too may be unintended, but are sometimes deliberate. The best-known forms of bias in biomedical literature involve the generation of content: for instance, clinical trials may be affected by selection bias, performance bias, detection bias, attrition bias, and reporting bias [18], as well as more bespoke contrivances pertaining to the clinical particularities in play [18-23]. Alongside such content biases, however, the attribution of articles has become increasingly vulnerable to systematic distortion, as attribution's complexity has grown, such that the simple term "misattribution" is unable to articulate the range and subtlety of potential distortion, and the concept of bias has become applicable. Accordingly, "credit bias" may be understood as the systematic distortion of attribution away from the truth about the work's origination, the parties responsible and their roles, typically in the interests of those with influence over the publication. Technically, a preferable term for this form of bias would be "attribution bias", but this term is used in psychology in the setting of attribution theory, and its replication here might lead to confusion. Much like biases related to the production of content, those relating to attribution may be inadvertent or knowing, subtle or crude, involve a multitude of devices, serve interests, and have a systematic character. Here, I will focus on pharmaceutical company literature as an important illustration of credit bias — but all literature is potentially vulnerable.

Before focusing on credit bias, let us briefly work through our four-step framework introduced above for analysing literature, by envisioning a drug corporation article reporting the results of a proprietary clinical trial in a high-ranking medical journal. Considering first this *setting*, the top medical journals targeted by industry have exceptionally high impact factors and prestige, and are superb marketing

vehicles for drugs. Their publishers profit handsomely in turn, by selling reprints to the companies for distribution to their sales prospects. For instance, it has been claimed that nine hundred thousand reprints of the disastrous VIGOR clinical trial report were sold by the *New England Journal of Medicine (NEJM)* to Merck for use as a sales aid, for several hundred thousand dollars [24]. But the association of journals with the drug industry complicates their standing within academic medicine and has been subjected to ethical criticism [24-26].

Moving to the second category, the key stakeholders and contributors to our article and the work it describes, the drug company is the most powerful stakeholder and by far the most active contributor in our scenario. However, the academic medical experts recruited into the clinical trial are also significant players, as is the journal itself and more importantly, its proprietors. Consequently, while drug industry articles serve the interests of the drug corporations whose research they report, they also service the interests of the academics involved and, in addition, the interests of journals and their corporate owners. For all these parties, the primary interest is typically the shared and positive one of conducting and publishing high-quality science, but other more worldly interests peculiar to each stakeholder may also come into play. Medical journal articles are often a contested space in which these different forces compete. Much criticism of industry practices in biomedical publications is deficient because it concerns itself solely with alleged industry manipulation of literature, when the reality is subtler — for if the interests of industry are the dominant ones in the literature it produces, it is by integrating different interests that this literature acquires its distinct character and remarkable power within medicine [27].

With respect to the third step in our analysis, the *determination of content*, drug corporations typically design their own clinical trials and privately own and analyse the data. When the published report is developed, companies may contribute to its content through the use of marketing agencies, ghostwriters and use of their own employees in manuscript development, as well as by selecting academics to participate whose contributions they can broadly anticipate and rely upon — that is, so-called “disposable authors” [27]. Much of the industry science that arises from this process is of a high standard and free from content bias, but inevitably too, systematic content bias in favour of the company’s own product has also been identified as a widespread problem [19-23, 28].

What then of the fourth step in the framework, the *attribution* of our article? Here, a frequent presentational concern for the company is to achieve credibility, trust and acceptance — for itself, and for its drug — by academic medicine, by journal editors, by prescribing doctors above all, and also by the wider public. Such concerns can lead to credit bias [29]. Typically, the attribution of industry literature is led by the academics recruited by the company to participate in the enterprise. The company by contrast is generally presented as a partner and

collaborator in the research, a supportive courtier rather than the instigator, designer, owner and prime mover it truly is [27]. Accordingly, with regard to *author selection* and *author order*, it is standard practice to place the academic authors at the front of the byline, thereby conferring on what is essentially an industry project a patina of academic leadership. For example, in an analysis of a cohort of industry-financed clinical trial reports in top journals compiled by Barbour et al [30], I found that of the 70 industry-owned and instigated articles with both academic and industry authors on the byline, all 70 articles had academics as lead authors [29]. The selection and ordering of authors is now increasingly being recognised as a site for attribution bias in other contexts, such as preference for men over women [31, 32] and authors from high income over low- and middle-income countries [33, 34]^a.

At the same time as academic recruits are foregrounded at the front of the author byline, the role of the company that owns and conducts the research is often smeared into lesser attributional devices, with vague language and omission compounding the effect [2]. For example, despite their major role, the number of industry employees permitted onto the author byline or credited elsewhere may be limited; the role of clinical research organisations, marketing agencies and ghostwriters is typically mentioned in the fine print at the end of the article, if at all; the role of the company is seldom described in detail in the text, and the fact that it owns the data as its secret property is seldom stated. It is very rare for companies to be credited for their *corporate* authorial role, for instance in the author byline itself or in the title; the company is instead typically credited with “support” or “funding”; or described as a “sponsor”; helping convey the misleading impression that it merely put up the money and provided some assistance, rather than ran the operation [29].

As noted above, however, the patterns of attribution frequently seen in industry literature service the interests of other stakeholders, and not just those of industry alone. They must also satisfy those of the academics involved, and those of the journal, and perhaps the expectations of readers as well. A former senior publications executive at Merck has argued that the industry practice of fronting its literature with academics is what medicine wants, and in consequence, if drug companies wanted to increase the number of their employees included as authors and place them at the front of the author byline, this might reduce the prospect of the article being accepted for publication in many journals, and excite the reflex scorn of some readers [35]. It is important too to understand that the attributional biases I have described in respect of industry literature are a matter of custom and culture as much as knowing strategy [36]. For instance, the use of academics as lead authors often follows on from their installation as lead investigators by the company that is the true master of the work, a practice which reflects historical, cultural and organisational factors as well as serving a public relations function. This does not

justify the foregrounding of academic recruits and downplaying of corporations in the attribution of this literature, but it illustrates that the roots and functions of credit bias may be complex.

All misattribution is ghostly

The most notorious forms of misattribution in industry medical journal literature are ghostwriting, ghost authorship and guest authorship. As the attribution of journal literature has grown more complex and the idea of a specific form of bias for attribution has become useful, such flagrant examples of misattribution can be understood as extreme forms of credit bias. So can the even more egregious practice of plagiarism, in which authors attribute to themselves the text or ideas of others. But as the example of industry literature shows, much credit bias involves subtler shades of misattribution, involving the detail of author bylines, disclosures and other devices.

The precise definition of practices such as guest authorship and ghostwriting is controversial and contested [2]. However, when attribution is considered from the standpoint of credit bias, what is important in determining whether the attribution of a piece is ethical is not whether or not it tallies with a particular definition, but simply whether the attribution gives the reader a fair, accurate and proportionate account of what took place, and who was responsible. One useful metaphor is to think of credit bias as a landscape, with occasional crude excrescences such as ghostwriting and plagiarism emerging like gradual peaks from within a terrain of varying levels of misattribution. Ultimately, if we use the “ghost” metaphor to refer to concealment within the attribution of biomedical literature, then *all* credit bias must be considered to have a ghostly nature, since any degree of attributional spin diminishes in the reader’s perception some aspect of the provenance and development of the article. Regardless of how ghostwriting and similar practices are defined, subtle ghostly practices involving partial visibility, ambiguity, vagueness or carefully-placed omission occur wherever there is credit bias, and accordingly, a trace of ghostliness creeps far and wide like a subtle fog through medicine’s journals.

Journal guidelines assist credit bias in industry literature

Journals set rules for the articles they publish, and editors have taken many steps over the last three decades to provide more detailed and ethical attribution. Throughout this time, an important concern for editors has been to protect their titles from scientific error and fraud, ever since this problem emerged as a major issue in the 1980s [37]. Accordingly, they have used authorship as a tool for enforcing individual accountability, by compelling academics who wish to be authors to accept personal responsibility for content that appears in their name. Eliminating fraud is a vital goal for science, but in focusing with such avidity on the responsibilities of the individual, editors have failed to take adequate measures to enforce *corporate* accountability, or

even visibility — most particularly, that of commercial enterprises such as drug companies.

The main organisation responsible for editorial policy in medical journals is the International Committee of Medical Journal Editors (ICMJE), a body created by some leading medical journals to set uniform editorial standards [38]. With respect to enforcing individual accountability, the ICMJE imposes a four-step formula on authorship, requiring that authors play some intellectual role in the project, make some meaningful revisions to the manuscript, approve the final version and agree to be personally accountable not only for their own role, but for ensuring their co-authors are properly investigated if a problem arises [38]. With respect to the responsibilities of companies, however, the ICMJE *Recommendations* are less stringent [1]. Among positive measures, the ICMJE requires articles to provide a brief account of the company’s role; ensure that academic authors have “access” to the trial data; ensure that clinical trials were logged in a public registry at or before the time of first patient enrolment; and disclose authors’ commercial interests. More negatively, however, the ICMJE supports the publication by journals of drug industry articles in which the data are kept secret, rather than insisting data should be made available for independent academic scrutiny if the material is to be published [39]. With respect to attribution, the *Recommendations* make no stipulations on author order, thereby protecting the standard industry practice of fronting its articles with academic authors. They make no requirement for the prominent labelling or notification of industry involvement, for instance in the title of the article or through naming the company itself as an author. They direct that writers should be credited only in the acknowledgements, thereby supporting the practice of ghostwriting, even when the ghostwriter is contracted not to the authors but to commercial parties, and writes intellectual content in their interest. Academic authors, by contrast, need merely play some passing role in conception and design, then make “revisions” to a manuscript they did not write, to be qualify as authors under ICMJE rules. It is an irony that an authorship formula designed to limit authorship provides assistance to parties who should be authors, but seek to avoid this role and the visibility it brings. As noted above, the ICMJE does require authors to describe the role played in their study by the funding source, but the requirement lacks detail, and permits disclosures to be inconspicuous and cursory. For instance, articles are not required to admit that their data are the company’s private property. The net effect of all these measures is to support systematic credit bias, whereby academics are given excessive prominence and the role of the company is incompletely described and placed in a subsidiary position.

It is now more than ten years since these flaws in the ICMJE’s rules on attribution were first brought to scholarly attention [40, 41], but the body has shown little interest in addressing the problem. In part, this is likely to reflect the continued

focus of the editorial community on individual responsibility, as well as its lack of understanding both of attribution and commercial authorship; but inevitably, editorial inertia on the issue will lead some to speculate about what interests might subtly weigh upon the body's decision-making. It should be reiterated that without the ICMJE guidelines the quality and attribution of medical literature would be substantially worse, and the value of their positive measures is clear; but the publication of secret, poorly attributed and sometimes poorly designed and reported commercial science that is fully ICMJE compliant remains a part of medical journal literature — one that is bad for science, but highly profitable for some journals.

Can standardising contributorship reduce credit bias?

While non-byline attribution can be used as a means of placing information out of the reader's gaze, it does play a valuable bookkeeping function in respect of accountability. For a decade, a community of groups with interests in information exchange, bibliography and open science has been developing the Contributor Roles Taxonomy (CRediT), a standardised set of scientific contributions. The project began in 2012 and is currently under the stewardship of the US National Information Standards Organization (NISO). Other groups such as the Consortia Advancing Standards in Research Administration Information (CASRAI) and more recently Force11 have also contributed, with the recent development of related technical initiatives such as the Contributor Role Ontology (CRO) and Contributor Attribution Model (CAM) [9-12]. Currently, The CRediT taxonomy captures 14 specific contributions, which are as follows: conceptualisation, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualisation, writing — original draft and writing — review and editing. Individuals who make these contributions acquire "digital badges" charting what they have done. An increasing number of journals are embracing the CRediT taxonomy — for instance, PLOS and Elsevier have adopted the scheme [42, 43]. However, it is generally only byline authors who are invited to describe their roles using the taxonomy, and the original goal of including all contributors, regardless of whether or not they are authors, has not yet been achieved.

What will the long-term effect of these developments be? Some have hoped that authorship *per se* will be supplanted by contributorship and die away, such that instead of being headed by author bylines, biomedical literature will merely list contributions [6,8]. This eventuality is highly unlikely, and perhaps undesirable. Authorship is likely to remain the principal form of attribution for medical literature, with its enduring challenges of ensuring the correct parties are listed as authors and properly arranged. CRediT's documentation of contributor roles is therefore unlikely to supplant authorship, but it provides biomedical publishing with an opportunity to expand attribution beyond authorship in a systematic and structured way. Unfortunately, this opportunity is in danger of being missed, for if the use of CRediT continues to be restricted

to byline authors only, its function will merely be to standardise the bookkeeping of credit and responsibility for them alone. While that is valuable, CRediT may therefore come to provide a further means by which non-authors are marginalised in biomedical literature, through their exclusion from the scheme. Furthermore, CRediT only documents the role of individuals, and is not currently designed to capture corporate roles, and this limitation will assist companies in maintaining a low profile in projects they own and control. To address these issues, CRediT should be expanded to document the role of all contributors and not just authors, and adapted to articulate the role of companies as well as individuals. Ideally, CRediT metadata should also be assimilated into searchable databases such as PubMed and the Science Citation index. Regardless of how CRediT evolves, however, it is certain to become a new setting for credit bias — although overall, its standardised format has the potential to improve the attribution of journal literature.

Conclusions: towards a new publication standard

In summary, I have advocated a systematic approach to the study of publications, based on four categories, which I have called *setting, context and perspective; stakeholders and contributors; content*; and finally, *attribution*. I have focused in particular upon attribution, a concept which has been little used to date by journal editors or within publication ethics. Attribution is not limited to authorship alone, but includes everything that is conveyed to the reader about the origins and development of the work, including all the parties involved, what they did and what their motives were. Attribution has documentary and bibliographic functions in assigning credit and responsibility, but it is also a form of communication with the reader; this psychological component has been little studied in the journal setting. Systematic bias in attribution, which I call credit bias, is a common problem in medical journal literature that has grown in scope as science has grown in scale and complexity, and as journals have sought to provide more detailed and complex attribution for the material they publish. Credit bias can occur in many settings, although I have focused here on drug industry literature. Credit bias may reflect the interests of one stakeholder or the variously contesting and aligned interests of different stakeholders. I have described how, despite many positive features, the ICMJE guidelines facilitate credit bias in industry-authored journal literature. Finally, I have evaluated recent attempts to standardise contributor listings, which while a welcome step may provide a further setting for bias. Credit bias is presented herein as a working concept of emerging relevance, and I look forward to seeing it developed and extended by other scholars.

Attribution will always be at risk of bias. Unfortunately, some of the worst abuses of attribution are deeply entrenched in publication culture, and are as difficult to eradicate as content-related biases — not least because they indulge the

self-interest of numerous stakeholders. I have long argued that academics and journals who care about science should establish an independent standard of integrity [27, 44], in which studies are only published if their data are available to independent academic scrutiny, if scientific methodology and reporting is rigorous and objective, and if attribution is truthful, detailed and balanced. Such a standard, with an identifying logo, would give readers increased confidence in the material in front of them, but the absence of the logo from recalcitrant journals would have the opposite effect. It is likely that the major publishing corporations would resist a standard seeking to enforce more exacting scientific rigor and openness, but that would perhaps not be a bad thing. The corporatisation of the journal publishing sector, the buying up and batch trading of journals as commodities, the transformation of titles into brands and the monetisation of their scholarly reputations through a mixture of editorial compromise and tawdry leveraging, has been more damaging to the quality of journal literature than the much-decried influence of pharmaceutical marketing. A new independent scientific standard would open up space for new journals, and perhaps new forms of scholarly communication outside the traditional journal model. Scientists, ethicists and editors with an interest in establishing such a standard should convene to determine its form.

Statement of competing interests

I received no support, remuneration or benefits of any kind for researching and writing this article.

Between 1994 and 2012, the majority of my income came from consultancy and writing services provided to pharmaceutical corporations, either directly or via marketing agencies.

In 2015, I acted as a paid expert witness on behalf of the plaintiffs in a US federal legal action against a pharmaceutical corporation.

In 2018, I provided consultancy services to a U.S. law firm on matters related to publications in the biotechnology industry.

I teach a one-off annual class on authorship at the University of Toronto as a guest lecturer.

Note: The difficulties faced by women and by academics from low- and middle-income countries in respect of author selection and order are underlain by further biases relating to the allocation of roles within projects and the basic opportunity to participate. Hence, the problem is not merely one of attribution bias, but of deeper “participation biases” within the structural organisation of science.

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