

Who's the Author? Problems with Biomedical Authorship, and Some Possible Solutions

Report to the Council of Biology Editors (now Council of Science Editors) From the Task Force on Authorship, February 2000

This report was written by Frank Davidoff. The members of the task force reviewed the report and provided critical comment and suggestions, and all have approved the final version. Eugen G Tarnow also contributed suggestions.

Billboards have recently appeared beside the highways in US cities asking, in huge letters, “Who’s the father?” DNA testing has arrived, and with it the matter of paternity, once shadowy and personal, has been rudely thrust into the light of public scrutiny. The parallel between that question and the question “Who’s the author?”, which drove the Council of Biology Editors (now the Council of Science Editors) to form the Task Force on Authorship, is striking. Both questions concern acts of creation: in the one case, new persons; in the other, new ideas. Both are being asked because of ambiguity or disagreement about those acts: Who gets the credit? Who can take pride in the product? Who should take responsibility? Who gets the money? Indeed, the analogy between paternity and authorship has long been used to justify intellectual-property rights and differentiate them from rights to straight material property.¹ Ultimately, both questions also concern acts that are regularly pressed into service in the battle against mortality; as Fitzhugh Mullan has said, “One’s written words become one’s offspring. The stories and their messages will live on as evidence of one’s presence on the planet and engagement with life”.²

Like all analogies, the analogy between authorship and paternity is imperfect. A child can have only one biologic father, whereas a scientific study can legitimately have many authors. But the analogy aptly calls attention to the ambiguity that is intrinsic to any published study with more than a single author, whether the number is two or 20. Other models may also help us understand why biomedical authorship works the way it does, for example, an economic model that views authorship as scientific intellectual property in a more or less efficient market. Those models may be worth exploring, but they were not considered by the task force and will need to be the subject of other reports.

As the task force peeled away the more obvious layers of the problem (such as the order of names on the byline), the intricacy and subtlety of authorship were increasingly obvious—myriad interwoven intellectual, social, emotional, and ethical elements—and the magnitude of the challenge to the task force equally obvious. Moreover, as in the case of DNA testing, many of authorship’s features have great symbolic meaning, often best understood through metaphor. The most prominent of these features are listed in the Table.

What was the task force asked to do, and how did it try to do it?

To come to grips with these issues, CBE created a Task Force on Authorship in May 1998. The broad mission of the task force was to help resolve some of the current tensions and ambiguities associated with biomedical authorship; its more immediate goal was to organize a retreat on authorship at the 1999 CBE annual meeting in Montreal.

The task force divided its efforts among four working groups, as follows. First, the White Paper Working Group was asked to undertake a kind of hermeneutic exercise on authorship, that is, to develop a “thick description crafted from differing perspectives”.³ The group was asked to consider a number of basic questions: What is the fundamental nature of authorship? In what ways has it changed? What are its problems, and what are the sources of these problems? It was asked to produce a background document that provides deep insight into why biomedical authorship is a matter of concern.

Second, a Research Working Group was asked to look at authorship empirically—to examine critically the data emerging from original research, primarily studies of institutional authorship policies and the description of author contributions now being published by a number of journals (contributorship systems).

Third, a Liaison Strategy Working Group was asked to identify all the organizations and constituencies with a direct, major stake in biomedical authorship. Our intent was to move the work of the task force beyond the short-term deliverables of a written report and a meeting. To that end we asked the Liaison Strategy Working Group to contact the leadership of the many stakeholders in authorship as a first step in developing an active process of study, debate, and action that extended beyond the life of the task force itself.

Finally, a Retreat Working Group was responsible for organizing a half-day retreat on authorship issues: the 1999 Montreal symposium.

The following highly synoptic, and far from complete, commentary on the current state of biomedical authorship—its problems, the sources of the problems, and some possible solutions—is drawn from many sources: the published literature (excellent reference lists are available in a number of places, including the CSE Web site, under Services/Authorship Task Force/List of selected references, at www.councilscienceeditors.org, and the Web site of the World Association of Medical Editors at www.wame.org); two meetings on authorship, at Nottingham (1996) and Berkeley (1998); the white paper from the task force;⁴ and the research presentations and discussion at the Montreal retreat.

What are the problems of biomedical authorship?

Judging from the increasing amount being written about it,⁵⁻¹⁰ the meetings devoted to the topic in Nottingham¹¹ and Berkeley,¹² and the rapid recent implementation by several journals of systems for gathering and publishing contributorship information, many persons involved with biomedical research (particularly journal editors) appear to be convinced that biomedical authorship (in the words of the country western song) if not exactly broke is at least badly bent. The problems with authorship are many, but two central themes underlie most of them: misattribution of credit and failure to take responsibility.^{4,8,10}

On the matter of credit, Gruber has pointed out that for many centuries authorship was a collective rather than an individual enterprise. In this tradition, a “great name” was layered onto a community of acolytes who caught the spirit of the founder and then onto another community of scribes, copyists, and editors, all of them adjoining their words into an emerging literature.¹³ Others have reminded us that anonymous opinion was popular 200 years ago because it was considered to be more “objective”¹⁰ and that in the 17th and 18th centuries (in the West, at least) the state, the prince, or the church “created” the author of a work by identifying someone as responsible for a given text.¹⁴ Over time, however, the concept of authorship shifted, increasingly being equated with the work of creation by individual persons. As a consequence, a set of linked problems in the attribution of authorship credit arose: Who actually did enough of the reported work to be considered an author? (Anne Hudson Jones refers to this aspect of authorship as the “author-as-creator”,¹⁵ reminiscent of biologic paternity.) Who reported the work? (Jones refers to this as the “author-as-writer”, which is perhaps more akin to adoptive paternity.) How are the contributions to creation and writing of the work publicly identified? It is important to note in this connection that until

the 18th century, the purchaser of a copy of a work was considered to be the owner of its content. The resulting widespread piracy led authors and publishers to create the legal construct of “intellectual property” and, ultimately, copyright.^{1,14}

In the current nonsystem of biomedical authorship, definitions of the quality and quantity of work that qualify someone for authorship appear to be scant and inconsistent. Those definitions that do exist (for example, the statement from the International Committee of Medical Journal Editors [ICMJE]¹⁶) and authorship policies developed by academic medical centers and scientific societies are not widely known or not respected. To make matters more confusing, definitions of authorship differ widely among the various scientific disciplines. And once a group of researchers has decided who will be listed as the authors of a study, the only clue they have provided readers as to the quantity and quality of each author’s contribution is the order of names on the byline, a time-honored but highly ambiguous system (“smoke signals”, in Rennie’s words).^{8,10,17-18}

Behind these pragmatic problems in misattribution of authorship lurk darker and more subtle ones: gift, guest, and ghost authorship.⁸⁻¹⁰ Gift authorship is authorship credit given “as either a tribute or a ploy for recognition, within the context of a reciprocal exchange or as the consequence of a dependence”,⁴ that is, listing as an author someone who has not contributed directly to the work but who is in a position to expect or demand authorship, for example, the head of a laboratory or someone who helped to obtain funding. In contradistinction to gift authorship, which is offered by the other authors from a sense of obligation, guest authorship is offered, sometimes with payment, even though others did the work and wrote the paper, because those others believe that the expert standing of the guest will increase the likelihood of publication and the credibility of the published work. Ghost authorship refers to the failure to identify as an author someone who contributed substantively to the research or the writing of a paper. The spectrum of ghost authorship is wide. Some ghost authors work for hire, with the understanding that they will not be listed as authors—voluntary ghosts, as it were. At the other extreme, researchers who have contributed substantially to the work are sometimes, and without their agreement, not named as authors and hence become involuntary ghosts—a practice that can be viewed almost as a form of plagiarism.

Taking credit for a study and being responsible for it are in many respects two sides of the same coin. At the same time, failure to take responsibility for the integrity of work as a whole and its reporting differs in many ways from misattribution of authorship credit.^{8,10} For one thing, failure to take responsibility

becomes a problem only if the conduct and reporting of the work are challenged (for example, as being sloppy, distorted, or fraudulent). In this sense, taking responsibility for a published study is a commitment to a kind of “aftercare” once a paper has been published, operating in the future, like insurance.¹⁹ Moreover, those who take responsibility for a study are in a sense double agents, in that they have obligations both to those doing the work and to the larger community. Failure to take responsibility for studies probably happens a good deal less often than does misattribution of authorship credit. When authors fail to take responsibility, however, the results are far more damaging: Misattribution of authorship credit is a personal failing that can damage an individual researcher’s reputation and career; failure to take responsibility is a social failing that erodes trust in science and scholarship and thus strikes at the very heart of the discipline. At the same time, it is probably often true that no author of a given work would actually be willing, or even able, to take responsibility for the work as a whole if the study were challenged. Such lack of guarantorship may frequently go undetected, however, because the integrity of studies is not often seriously challenged.

What are the sources of these problems?

Misattribution of credit and failure to take responsibility are unlikely to happen when studies have only one author (although a single author can of course fail to include as an author someone who has made major contributions and can blame a nonauthor for a study’s failings). Many of the current problems with biomedical authorship thus arise from, or at least are exaggerated by, the increasing number of contributors to any given biomedical work.¹⁰ Biomedical research is increasingly “more an orchestrated production than a creative act by individual scientists”.¹⁶ This has occurred largely because the wide range of knowledge and skills required by many current research projects demands participants from a variety of disciplines, each making an essential but highly specialized contribution to the study (often the “contribution” of patients, special reagents, and the like). Data from the *BMJ*²⁰ and elsewhere¹⁰ indicate that the number of authors per published paper in biomedicine has, in fact, increased progressively in recent years. The price paid is frequently an agreement to list as authors those who have made these narrow or specialized contributions.

But failure to preserve the integrity of authorship can hardly be attributed to any single factor, such as the growth of multiple authorship. Indeed, an important insight

that emerged from the deliberations of the CBE task force was that many problems with the integrity of authorship are system problems rather than problems with the attitudes and behavior of individuals—a finding that is proving to be true of problems with quality in many endeavors. As noted, the current system of biomedical authorship is complex, involving many stakeholders. What Richard Horton described as “the circumference of authorship” extends widely and can be understood to include reviewers, editors, perhaps even readers.²¹ And as is also true in other complex systems, even though each element of the system by itself may be said to function reasonably effectively and rationally within its own domain, the interactions among the many parts of the system may lead to serious malfunctions of the authorship system as a whole. What follows is a brief sketch of the various stakeholders, their interest in authorship, and the ways in which those interests interact with others to create many of the current problems of authorship.

• ***Individual researchers***

All investigators who do original research or other scholarly work are interested, understandably and justifiably, in being recognized individually for their intellectual curiosity, for their preparedness of mind, creativity, and hard work. But all know that to survive in academic life, both within their own institutions and beyond, they have to compete for prestige, authority, power—and funds. Success in this enterprise depends generally on being publicly identified as authors, and for academic promotion in particular, first authorship is the gold standard.²² In this system, authorship on a given study rapidly comes to be seen as a zero-sum game—that is, if someone wins, someone else must lose—rather than as a process in which credit is available to everyone in proportion to their contributions, and everyone works in common to support the scientific endeavor.

The current system of science funding also contributes materially to the way authorship is used and misused. A junior investigator who could command funding to support himself or herself would be in a position to write papers as the sole author. The difficulty in getting funding means that senior researchers spend much of their time obtaining grant support, with the result that their principal contribution to an individual research project may often be finding that support. But if senior researchers are not included as authors, why would they want to apply for funding?

• ***Research groups (including laboratories and departments)***

The social and interpersonal dynamics of research groups, whether two

collaborating colleagues or a large, diverse team, have much to do with the way decisions about authorship are handled for each study. Some groups operate on highly egalitarian principles (often agreeing that all members will be authors and all will be publicly acknowledged as having made equal contributions); others are rigidly hierarchic. Some agree up front on how matters of authorship will be handled; some never deal with the issue as a group at all, but leave it to be decided by the group's leader (or sometimes the leader gives them no choice in the matter).

- ***Supporting institutions***

Research groups never function in isolation; they operate in the context of larger supporting institutions, such as universities, research institutes, or professional societies. On matters of authorship, every institution in the United States that undertakes federally funded research is required to have an office of research integrity, but in many countries such offices don't exist. Some academic institutions have the benefit of strong administrative leadership, well-developed authorship policies, and effective administrative mechanisms for implementing those policies (for example, education programs). In others, something of an administrative vacuum exists in these areas.²³ Perhaps the most important institutional factor bearing on authorship in academic life is, however, policy and practice regarding academic promotion. Quantity of publication—particularly, as noted, first authorship—is the currency of the academic marketplace, although politics and prestige admittedly sometimes overshadow authorship, even first authorship. Promotion committees are generally made up of members who have been judged by exactly those criteria. It is not surprising, therefore, that the system perpetuates itself, inasmuch as promotion committees made up of such members tend to apply the performance measures by which they were judged.

- ***Scholarly disciplines***

Researchers within a field or discipline share not only their intellectual interests, but also traditions and values—in effect, an entire social-scientific culture. These disciplinary social norms cut across institutional and geographic lines and directly affect the matter of authorship. For example, research in particle physics is absolutely dependent on large teams of highly specialized participants. At the time they come together to organize a research project, the members of many particle-physics research teams develop an authorship “contract” among themselves. Authorship is typically shared by every member of the team, whatever their

contribution, and every author is expected to review each draft of the manuscript. The result is that papers in this discipline may have dozens of authors, sometimes with more page space devoted to the list of authors than to the text of the scientific report itself. Although the authorship arrangements of research groups in physics share some features, they may vary considerably from group to group. In an effort to minimize variation in authorship criteria, members of the physics community have recently developed a statement on authorship,²⁴⁻²⁵ although awareness of that statement among research physicists is apparently still quite low.²⁵

• ***Journals and journal editors***

Over the last 20 years or so, biomedical journal editors have begun to take quite seriously their responsibility for defining authorship, at least judging from the highly specific authorship criteria set forth nearly 20 years ago by the ICMJE and now adopted by perhaps 500 or more biomedical journal editors.¹⁶ Curiously, however, biomedical journal editors have been unwilling or unable to assert their authority in implementing those criteria. More specifically, they have limited themselves to publishing the ICMJE criteria in their journals' information for authors hoping that authors will abide by them, even though all editors know that many authors fail to read, or to honor, most of the information for authors.²⁶⁻²⁸

In fact, the very same editors who are absolute hawks in demanding full disclosure of every nuance of experimental procedure have been unwilling to demand even a shred of information about the specific contributions of authors listed on the byline. Lacking that information, few if any editors have been in a position to enforce adherence to the ICMJE authorship criteria. Similarly, editors have made no effort to develop and implement a consistent system for determining the order in which authors are listed on the byline. Developing a method for the unambiguous representation of authorship on the printed page remains an unmet editorial challenge.²⁹ The editorial policy of journals has contributed to a scramble for authorship in yet another fashion: To conserve page space, most print journals have limited the number of authors listed in the reference citations at the end of a published paper, usually to fewer than six names. In an effort to increase their academic visibility, some researchers therefore push to be sure that their names are included among the first six listed on the byline.

• ***Funders***

Those who fund research and scholarship are understandably interested in

increasing the likelihood that the studies they support will be productive. One measure of investigators' potential future productivity is their record of previous productivity, which, of course, is most easily and frequently measured by authorship. Researchers know that, and it reinforces the competition for authorship citations, particularly first authorship.

- **Industry**

Commercial firms, particularly pharmaceutical companies, provide support for both basic science and clinical studies, and corporate employees are themselves frequently researchers in these studies. Until recently, however, few commercial firms in the biomedical sector have had formal authorship policies for their employees. Many were, in fact, reluctant to let employees' names appear on the byline at all, or they required that employee names be in the minority, to avoid the impression of undue commercial influence. For commercial purposes, companies have also on occasion invited well-known experts to be guest authors on papers written by company employees.^{8,10}

These ghost and guest authorship practices have come under increasing scrutiny in recent years from both inside and outside industry. A number of companies have now developed formal authorship policies and are in the process of implementing them. Companies appear increasingly willing to allow the names of the employees who have done the work to be listed on the byline.³⁰ These trends need strong encouragement and should be supported through closer interaction with the other stakeholders in biomedicine.

- **Libraries**

Although libraries are in some respects the passive recipients of what authors produce, the indexing decisions made within the library system have had substantial effects on the way authorship information is created, distributed, perceived, and used. For example, the National Library of Medicine has set limits (which have changed over the years) on the number of authors per paper that it will actually include in *Index Medicus*. (That policy is about to change: beginning in mid-2000, *Index Medicus* and MEDLINE will no longer limit the number of authors listed for each article.)³¹ The limits imposed in indexing systems have in turn encouraged journal editors to restrict the number of authors listed on a published paper—with obvious implications for authorship decisions within research groups.

- **The law**

Copyright law also sheds light on the nature of authorship. The law says that copyright applies to a document from the moment its content is “fixed in any medium” by the author. It has also decreed that copyright does not apply to a document unless its content reflects meaningful creativity.^{24,32} The courts have ruled that the telephone book, for example, cannot be copyrighted, because putting it together is essentially a mechanical task involving no creative input.

- **Government**

As the major funder of biomedical research in many countries, governments have a substantial interest in authorship. That interest is perhaps most obvious in funding agencies’ need to know about investigator productivity in connection with applications for research funding; authorship on published papers serves as the principal documentation of productivity. (Government interest in authorship has occasionally emerged in other forms, for example, in the United States when some members of Congress mounted aggressive attacks on gift authorship).³³ Interestingly, the Office of Research Integrity (ORI), the principal agency of the US government dealing with matters of research ethics within the National Institutes of Health, explicitly excludes authorship issues from its official purview. By doing so, it apparently means that it does not become directly involved in disputes about authorship credit, partly because such disputes are so common and hard to sort out and would therefore constitute an undue burden, although ORI has issued advisory guidelines to biomedical journal editors on principles of authorship.³⁴⁻³⁵ ORI’s main concern, rather, is with the various aspects of research misconduct. Thus, to the extent that ORI takes direct responsibility for authorship issues, it is through its efforts to ensure that authors guarantee the integrity of the work, which includes guarding against plagiarism and dealing with such ethical issues as conflict of interest.

More generally, the role played by government in the conduct of science appears to vary substantially from country to country. We need more information on that role and on how it affects the definition, expression, and integrity of authorship in different countries, if government is to be included effectively in improving the authorship system.

How might these problems be fixed?

Those who undertake to fix the problems of authorship (a list that, as noted below, includes many others besides authors themselves) will need both to take

responsibility and to assert authority to get the job done. On the face of it, responsibility and authority seem to be inseparably linked—two sides of the same coin. The reality is that in many realms of life, responsibility and authority are often forced apart, to everyone's detriment: Responsibility without appropriate authority leads to frustration, and authority without appropriate responsibility fosters autocracy. At least part of the reason that authorship continues to be troubled is that the responsibility for dealing with its problems and the authority to do so, when asserted at all, have not been distributed in any rational or coherent way among the various stakeholders in the authorship system.

The first proposal for fixing the problems of biomedical authorship, then, is a general one:

- ***Coordinate the efforts of all those who have a stake in authorship***

This effort would, in effect, be an extension of the Liaison Strategy Working Group of the task force. It rests on the basic quality-improvement assumption that the problems in authorship are substantially system problems rather than attributable to the misbehavior of a few individuals in the system; they must therefore be addressed primarily by reconfiguring the system as a whole. An obvious starting point for such an effort would be to create a formal consortium of the various groups that have a stake in authorship—researchers and research groups, supporting institutions, journals and journal editors, professional disciplines, funders, libraries, the law, and government. A consortium of this sort might be begun by organizing a meeting of the senior leaders and decision-makers in those groups. The purpose of the meeting would be to decide who should have the responsibility and who the authority for implementing and maintaining changes in the various parts of the authorship system (see below for specific suggestions)—a kind of responsibility-authority matrix. The group would also need to consider such matters as

- Strategy: whether to focus primarily on “carrots”, such as encouraging voluntary buy-in of the various stakeholders to changes in the system (for example, education programs, publishing and using contributor information),²² or to resort to “sticks” by using a more prescriptive approach (for example, mandating those changes through rules and regulations), or both.
- Perspective: the research procedures, group dynamics, and value systems differ widely among various scholarly disciplines; these differences need to be taken into account.

- Priorities: changes that are likely to be both most feasible and effective (the “low hanging fruit”), changes that are important but can wait, and so forth.

- ***Expand the publication of contributorship information***

Several proposals have been put forward for documenting researchers' contributions.^{10, 36} At this writing, six biomedical journals—*American Journal of Public Health*, *Annals of Internal Medicine*, *British Medical Journal*, *Lancet*, *Physical Therapy*, and *Radiology*—have begun collecting and publishing information on author contributions, and a seventh journal, *JAMA*, will begin doing so in 2001. In so doing, the editors of those journals have moved beyond taking responsibility, which they have done for some time by adopting and publishing the ICMJE authorship criteria, to asserting authority, which they have not previously done. Requiring authors to disclose their contributions and publishing that information create a new standard of disclosure, a level of transparency consistent with the established high standards for the reporting of scientific information generally.

Biomedical journal editors and others need to engage in a campaign to persuade more of their colleagues to adopt contributorship systems. When a large proportion of journals start publishing contributorship information, it will become a de facto norm, with wide implications for academic promotion and research funding. Widespread use of contributorship systems will also create a number of important research opportunities, making it possible, for example, to study the value of free-text descriptions of author contributions vs prespecified categories, variations in contributions across journals, scientific disciplines, countries, and the like. Editors and others might also push to have contributorship information indexed electronically, which could help in locating experts in various subfields, particularly very small ones.

- ***Consider redefining the criteria for authorship***

As long as some who participate in a research study are listed on an author byline and others are not, disclosure of researchers' contributions, however helpful, still does not answer the question “Who’s an author?” That question can be answered only on the basis of criteria that define authorship, as the ICMJE has tried to do. The problem, as noted above, is that a substantial proportion of biomedical researchers appear either to be unaware of the criteria established by journals or to disagree with them.^{27,28} The editors of biomedical journals, meanwhile, have been either unwilling or unable to enforce them (that is, to allow

on the byline only names of contributors who actually meet their own journals' authorship criteria). The result is that, according to their own description, more than one third of those listed on such bylines fail to meet the ICMJE criteria.^{17,18}

Continued neglect of this large gap between principle and practice can only devalue the principle, eventually making a mockery of it and contributing to the kind of cynicism that is already engendered among young researchers when they encounter such abuses as gift authorship and involuntary ghost authorship.³⁷

Given those realities, journal editors, researchers, and the university community have two choices: They can either tighten up on adherence or change the standard. As noted, some biomedical journal editors have taken an important step toward tightening up by collecting and publishing contributorship information, which at the very least provides continuing public disclosure of the gap between policy and practice. On the other hand, Anne Hudson Jones's research has revealed that universities may be taking the alternative tack of changing the standard; she found that the small number of formal written authorship policies that do exist are generally less stringent than those of the ICMJE. More specifically, the policies recognize full authorship for those whose contributions meet some, but not all, of the ICMJE criteria.³⁸

Is it time for medical journal editors, perhaps working through the ICMJE and the World Association of Medical Editors, to redefine the criteria for authorship that journals and their editors will use? Is it time to make the criteria more flexible, more realistic? Perhaps. But what would be the result of such changes, which many would view as a serious compromise of intellectual standards? At the extreme, the stakeholders in authorship might agree to do away with defined authorship criteria altogether, taking the view that such criteria are irrelevant as long as credit and responsibility for contributions are appropriately and transparently assigned (some would argue that they have already been done away with, *de facto*). These approaches deserve serious and extensive consideration. It is also worth noting in this connection that the current ICMJE authorship criteria apply only to original research; criteria specifically for authorship of secondary or synoptic papers (such as reviews) do not exist. Is it also time to develop those criteria?

- ***Rethink the dichotomous structure of authorship***

Participants in biomedical research projects face a stark choice: They can either be listed on the byline as authors or be relegated to the acknowledgments,

which are usually published in small print at the end of the article. This dichotomous system means that middle-level contributors to a study (persons who have made substantial contributions but don't quite meet a strict standard for authorship, such as the ICMJE authorship criteria) don't receive appropriate public recognition; for purposes of academic credit and funding, they are in effect invisible. It can hardly be surprising that the current system breeds discontent.

But nowhere is it written that the state of authorship is intrinsically dichotomous. Indeed, some 15 years ago Fotion and Conrad suggested that those who have contributed materially to a study but have not met strict authorship criteria (for example, those whose only contribution was to provide patients to a study and care for them) should be listed alongside the authors in a second, separate category, under such a heading as "Clinical investigators" or "Participating investigators".³⁹ The third category of "Acknowledgments" would be reserved for those whose contributions are more limited and more purely technical.³⁷ A three-way (trichotomous) system of this kind has various attractions: It would reflect reality more accurately than the dichotomous system; it would also immediately eliminate many of the problems of gift authorship.

The specific contributions of all three groups in a trichotomous system—authors, participating investigators, and acknowledgees—should be published, for the same reasons that they should be published in the current dichotomous system. But publishing contributorship information would not eliminate the value of a three-way categorization of contributors, or at least not so long as journals, as well as funding agencies and university promotion committees, continue to make and to value the distinction between authors and all others. Indeed, three-way listing would become moot only under a full, undifferentiated "movie credit" system of contributorship, that is, a system in which all those who contributed to the study are included in a single list with their contributions. In such a system the concept of an author as someone who makes a unique contribution would simply disappear.¹⁰

Editors have the authority to create three-component systems of authorship and should experiment with them. For such systems to work, however, university promotion committees, funding agencies, and the National Library of Medicine would all need to agree that they were of value. The parties with a stake in authorship would need to resolve a number of questions, including what credit would be attached to being a "clinical investigator", "contributing author", or "contributor"; whether information on middle-level contributions would be included

on CVs; and whether that information would be indexed by libraries and journals in bibliographic citations. Those groups have the authority to resolve these questions, and they should exercise it.

• ***Explore quantitative weighting of author contributions***

Publication of author contributions does not weight their importance within a study. (Comparing the importance of contributions to a study to that of authors in other studies depends to some extent on the importance of the studies themselves, a matter that lies outside this discussion.) Contributorship information therefore does not resolve the ambiguity of position on the byline, which remains potentially a source of disagreement among researchers (unless, as is sometimes done now, a group explicitly agrees to state that all authors contributed equally to the study). Failure to weight the importance of contributions also limits the usefulness of contributorship information to promotion committees and funding agencies, not to mention readers.

Two professional disciplines—family medicine⁴⁰ and (perhaps not surprisingly) biostatistics⁴¹—have explored the use of standardized numerical systems for weighting author contributions. Although interesting, such systems have their own problems: They are not easy to develop, they can be cumbersome to apply, and need to be both validated and standardized if they are going to be truly useful. Despite their potential limitations, the feasibility and utility of these systems should be seriously explored as part of a general effort to increase the clarity and meaning of author contributions.

• ***Explore the use of a “patent” system for assigning authorship***

Because so much is at stake, legally and financially, for patent holders, the procedure for deciding on patent authorship has little of the “wild West” quality of biomedical authorship (and scholarly authorship in general). Rather, at least in the current US patent system, an attorney not associated with the research inquires into the work that various researchers contributed to the invention or discovery and, according to the existing legal standards for patent authorship, writes down the list of patent authors.²⁵ Tarnow has recently suggested that a similar procedure, perhaps involving a “disinterested party” other than a lawyer, might be adopted for the assignment of authorship in biomedical (and other scholarly) work.²⁵

- ***Explore the potential of electronic systems***

Editors are right: Many authors don't read journals' information for authors or, if they do read it, tend to ignore or overlook it. But if authors were required to submit their manuscripts electronically, journals could create Web-based submission templates that incorporate the key provisions of the information for authors. Such systems would walk authors through the steps in manuscript preparation required by journals, thus ensuring reasonable conformity with at least the essential editorial requirements. For example, the system could be designed to accept a manuscript only if the authors' contributions were listed and the text fell within a specified word limit. Such systems would reduce or eliminate the administrative hassles associated with obtaining contributorship information from authors, a problem that has been of substantial concern to editors. The downside, of course, is that the templates for manuscript submission could evolve into bureaucratic monstrosities, like other forms now in use (witness the federal income-tax return). Every effort would need to be made, therefore, to keep such templates flexible, simple, and user-friendly.

- ***Pursue methods for ensuring and identifying guarantorship***

Although so-called contributorship systems can include information on both credit (who contributed what) and responsibility (who speaks for the integrity of the work as a whole),⁶ these two aspects of authorship are distinct. Indeed, although some of the journals that now publish information on author contributions (for example, *BMJ* and *Radiology*) also identify one or more guarantors of the integrity of each paper, others (*Lancet* and *Annals of Internal Medicine*) do not.

Guarantorship is clearly a crucial issue with regard to research integrity, and it is also clearly a component of authorship. Unfortunately, although it is relatively easy for authors to specify what they have contributed, it is not always easy to establish who is responsible for the integrity of all aspects of a research project, particularly in large, multiauthor, multicenter studies. Moreover, as noted above, the reasons for identifying guarantors differ from the reasons for identifying contributions, in that contributorship primarily recognizes past actions and guarantorship operates largely in response to future challenges. That is, once most individual authors have made their contributions, their role is largely passive: to receive credit (where credit is due, ideally). In contrast, guarantors may need to take an active, continuing role, responding to questions raised about the work or challenges about its integrity. And although all researchers at some level bear an obligation to the

wider community, their principal responsibilities are to their fellow researchers and the study itself. In contrast, the formal obligations of guarantors by definition extend more broadly, to their sponsoring institution, the research community as a whole, the funders, and the general public. Similar distinctions are made, of course, in many other realms of life, for example, between the responsibilities of a company's employees, which are primarily to the company itself, and those of its CEO, which extend more widely; or between the responsibilities of a player on a sports team (who gets benched if he or she fails to perform) and those of its coach (who gets fired if the team fails to perform). The nature of guarantorship, its relation to authorship, and how it is best handled need further deep thought and considered action.

- ***Catalyze changes in academic policy and procedure***

The traditions of authorship are so deeply engrained in academic culture that some are skeptical of academic institutions' ability to play a leading role in changing the nature of scholarly authorship. But academic institutions provide the local environment in which research takes place; they play a key role in the way authorship is used and misused. It seems self-evident, therefore, that a number of fundamental changes in academic institutional policies and procedures will be needed if the current problems of authorship are to be even partly solved. Unfortunately, as noted, relatively few academic institutions, at least in the United States, have formal policies on authorship.³⁸ Moreover, those policies differ widely from one another and vary greatly in depth and detail. Even in institutions that have authorship policies, faculty are often unaware of the policies or choose to ignore them.

There is obviously a great deal of room, and need, for improvement here. To begin with, all universities, medical schools, and research institutes, as well as commercial companies that perform and publish research,⁴² can and should develop explicit policies on authorship. Institutional authorship policies should be basically consistent with the policies of professional disciplines, funders, and journals; in the interests of fairness and utility, institutional policies should conform as closely as possible to an agreed-on national, or even international, model policy, although it is unrealistic to expect they will be identical in all institutions. The policies will need to be general enough to accommodate the many disciplines represented on their faculties, yet specific enough to be enforceable and have teeth—not an easy task, but an important one. CSE could initiate such efforts by sponsoring a

consensus meeting, like the one in 1995 that drafted peer-review guidelines.⁴³

Even the best written policy is not of much value if it lies unused in a drawer. Academic institutions will therefore need to figure out how to make authorship policy a meaningful and active part of their value system and how to build it into their administrative processes and procedures. Offices of research integrity are now common in institutions that do biomedical research. To the extent that those offices take an active role in both prevention (for example, through effective education programs for faculty and students) and response to problems (through the services of an efficient, knowledgeable ombudsman to deal with complaints and abuses), they constitute a major step in the right direction.

Most important, however, would be a change in the policies and procedures of promotion committees, both departmental and institution-wide. As long as quantity rather than quality of research contributions dominates the promotion process, as it does now in most institutions, and as long as the nature and importance of authors' contributions remain obscure, as they do in the present system, the meaning of authorship is unlikely to change much, if at all.

Closing remarks

For obvious biologic reasons, it is not always clear who is the father of a child. Men have hidden behind that ambiguity, using it to claim or disclaim responsibility and to maintain power in relationships. Obscurantism is also useful in maintaining power relationships among researchers. It may be more than coincidental, then, that the long-standing tradition of obscurity and ambiguity in biomedical authorship developed in a research community that, until recently, has been almost exclusively a male preserve. But the billboards now appearing in US cities don't ask "Who's the mother?" There's never ambiguity on that score (although even that assumption is a little shaky in these days of new reproductive technologies). It may also be more than coincidental that the move to transparency about research contributions has developed in parallel with the entry of large numbers of women into academic life, including biomedicine.

We don't know, of course, whether women's increasing presence in bioscience is cause or effect, that is, whether it has contributed directly to changes in the system of authorship or is simply one among the many changes—increased public funding and public accountability, the explosive development of technology, more demanding standards for evidence, increased collaboration with industry, more frequent direct payoffs from patentable discoveries, and others—that have swept

through the “ecosystem” of biomedicine in the last few decades. Whatever the reasons, the monolithic system of values that has dominated biomedical authorship for many years appears to be breaking up. As a consequence, the biomedical research community is also new to efforts to deal with the problems of authorship. Those efforts are fragile and need strong support because over the long term a healthy biomedical research ecosystem absolutely requires a healthy system of authorship.

Note added in proof: The ICMJE recently revised its statement on authorship. See www.icmje.org.

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Authorship Issues

Personal

- Contributions and contributorship
- Creativity, performance
- Credit, prestige, authority, power
- Enduring legacy
- A gender and parenting issue?

Social

- Responsibility: reparation vs improvement
- Rules, regulation, policy
- Group (“orchestrated”) production
- The widening circle of authorship
- Research groups: departments, universities, disciplines, journals, funders
- Academic currency

Ethical

- Abuses that compromise ethical principles: ghost, guest, and gift authorship
- Conflict of interest
- Transparency, disclosure, “inscription under oath”

Legal and legislative

- The law, particularly copyright
- Government regulation and oversight