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ISSN: 0898-9621 (Print) 1545-5815 (Online) Journal homepage: <http://www.tandfonline.com/loi/gacr20>

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To cite this article: Jason Borenstein & Adil E. Shamoo (2015) Rethinking Authorship in the Era of Collaborative Research, *Accountability in Research*, 22:5, 267-283, DOI: [10.1080/08989621.2014.968277](https://doi.org/10.1080/08989621.2014.968277)

To link to this article: <https://doi.org/10.1080/08989621.2014.968277>



Published online: 30 Apr 2015.



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# Rethinking Authorship in the Era of Collaborative Research

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The size and complexity of research teams continues to grow, especially within the realms of science and engineering. This has intensified already existing concerns about relying on traditional authorship schemes as the way to allocate credit for a contribution to a research project. In this paper, we examine current authorship problems plaguing research communities and provide suggestions for how those problems could potentially be mitigated. We recommend that research communities, especially those involved in large scale collaborations, revisit the contributor model and embrace it as means for allocating credit more authentically and transparently.

## INTRODUCTION

In many research realms, especially in science and engineering, it is increasingly common that researchers work in collaborative teams. Collaborations are often necessary because they bring together the technical knowledge, skill, and resources to accomplish goals that could not otherwise be achieved. However, the growth in collaborations, in terms of the amount of them and the number of researchers involved, generates many complexities, which can significantly affect research design and conduct, and publication practices. Collaborations raise serious ethical issues, including ones pertaining to authorship, which research communities need to address systematically. As the Montreal Statement on Research Integrity (2013) states, “Fostering the integrity of collaborative research is the responsibility of all individual and institutional partners.”

Large scale collaborations can exacerbate the already existing difficulty of assigning proper credit to each member of a research team. For example, the order of authors is often used as a proxy for indicating the relative significance

of each person's contribution, but that credit allocation strategy has serious failings. Moreover, research misconduct and improper authorship practices may be closely interconnected (Resnik, 2006; Martinson et al., 2005; Claxton, 2005a; Scheetz, 1999).

The aim in this article is to provide suggestions for how current authorship problems could be mitigated. We recommend that collaborative research teams and communities should embrace a contributor model as a means for transparently indicating specific roles on a project while reserving the "author" designator only for those who directly participate in the manuscript writing process. An intended byproduct of this recommendation is to more clearly and concretely decouple the writing of a manuscript from being a necessary condition for receiving recognition for a contribution to a research project.

## THE TRADITIONAL DEFINITION OF AN AUTHOR

Historically, the definition of an author entailed that the individual in question crafted at least a portion of the language contained within a published work. Colloquially, this is the prevailing way that the term is understood (*Merriam-Webster*). In the academic world, a link is often established between being listed as an author and having a role in writing a manuscript (Marušić et al., 2011, 13). If understood in this way, authorship denotes that the named person is entitled to some portion of the credit for writing the manuscript in question and should be held accountable, at least in part, for its content.

Some academic communities still hold to the traditional notion of authorship. It is the default setting in fields, such as philosophy, where single author works are the norm or where the main intellectual effort for projects is the creation of a written product. It is also the standard convention in fields such as political science, the law, and economics, where collaborative teams tend to be rather small in size. Moreover, the traditional definition of the term seems to hold nearly universally within the context of authoring a book (Knoll, 1997).

## AUTHORSHIP IN SCIENCE AND ENGINEERING

According to Claxton, "before modern times, the authors (including scientific authors) of a work were regarded as both the "originators" and "authorities" of that work" (2005b, 33). Yet, the perception of what being an author means, as Claxton discusses, has noticeably shifted over time. Some organizations and journals within the realm of science and engineering directly address whether participating in the writing process is an authorship requirement. Within its authorship criteria, the International Committee of Medical Journal Editors (ICMJE) declares that each author should have a role in "Drafting the work or revising it critically for important intellectual content." Yet this is a necessary

but not sufficient condition for authorship according to the ICMJE. The ICMJE delineates three other authorship criteria, which are not directly tied to “drafting the work”. Similarly, the Institute of Electrical and Electronics Engineers states as one of its three criteria that each author must have “Contributed to drafting the article or reviewing and/or revising it for intellectual content” (IEEE, 2014, p. 84). Yet, someone could legitimately be included as an author in accordance with ICMJE’s or IEEE’s policies, assuming that the other criteria have been met, if the co-author merely revised the manuscript without contributing much else to it.

On many occasions, researchers, especially in science and engineering, do not write anything in a published work for which they receive authorship credit. This practice is reinforced by journal guidelines that do not insist on requiring each author to contribute to the writing of a submitted manuscript or that are silent on the issue. Authorship practices in theoretical physics are illustrative here; it is fairly common for published papers in that realm to have well over 100 authors (King, 2012). In one publication, for example, approximately ten pages were needed to list all of the individuals who met the research team’s criteria for authorship (ATLAS Collaboration et al., 2012). Considering the sheer number of individuals involved, it is highly unlikely that all of them were directly involved in crafting the phrasing used in the resulting paper. In fact, the American Institute of Physics (AIP) states in its publication guidelines that “Authorship should be limited to those who have made a significant contribution to the concept, design, execution, or interpretation of the research study.” AIP’s statement emphasizes the importance of contributing intellectually to the research but does not directly mention, as a necessary condition for authorship, that each individual included has to have a direct role in drafting the manuscript. Given the prestige of being named as an author, professional organizations and their respective journals are tacitly sending the message that activities such as data collection, analysis, and interpretation are as valuable, or even more valuable, than crafting a project’s written description.

## **PROBLEMS WITH THE CURRENT AUTHORSHIP SYSTEM**

In an age of large collaborative research projects, the fundamental core of what it means to be an author is difficult to pinpoint, which is illustrated by how many different definitions of authorship are contained within journal guidelines (Marušić et al., 2011, Table 1). The author list on a manuscript is often used as a proxy for determining who made which type of contribution to a project. Yet, decoding what the list means and who even actually wrote the relevant manuscript is quite difficult. Being an “insider” to a particular research field or subfield may almost be necessary to decipher how to interpret a particular author list. Moreover, the traditional definition of an author,

upheld by many scholars in the humanities and social sciences, and a more “expansive” definition are operating in the research realm simultaneously, which can generate conflict when working across different fields.

Because of this and other factors, such as the growth of international collaborations, authorship complexities have been intensifying. For example, many graduate students are working on collaborative projects while trying to construct a thesis or dissertation; this can complicate the process of determining which portions of the work “belongs” to a particular student. It is rather common in science and engineering that the published papers emerging out of a dissertation have co-authors even though the dissertation itself must have a single author, i.e., the student who is seeking to graduate. A common strategy, or “tradition,” for handling the situation is that the student who writes the thesis or dissertation becomes first author on any of the resulting published papers. Yet, researchers are probably aware that this tradition is not sacrosanct; in some circumstances, the advisor will seek to be the first author. Furthermore, a resolution is needed, especially on large collaborative projects, for which portions of the work can legitimately be used to satisfy degree requirements and which are the intellectual property of the research team. This is only one of the challenges at the intersection of authorship and collaborative research; others will be discussed below.

## **THE LACK OF PARTICIPATION IN THE WRITING AND REVIEW PROCESS**

Presumably, if a researcher is part of a collaborative team and does not participate in the team’s writing process, the probability decreases that the researcher will have examined the final, or perhaps any, version of a manuscript submitted for publication. Reviewing and approving the final version of the manuscript is nearly a universal requirement stipulated within journal guidelines. Since the size of collaborations is growing, it diminishes the likelihood that the respective contributions of each collaborator have been reviewed by other research team members. Junior researchers can certainly detect implicit cues from their project director, department, or organization if the writing process is deemed to be an “afterthought.” Admittedly, writing is not the paramount component of every researcher’s job, but the published paper is the main vehicle for communicating research findings to colleagues and the broader world.

## **OUTSOURCING WRITING**

The use of “pay-for-hire” writers is a growth industry, especially in the biomedical realm (Wislar et al., 2011). Its emergence is due in part to the ongoing dilution of what authorship on a research project means. The extent to which

the practice occurs is hard to discern given that students, faculty, corporations, and others have obvious reasons for hiding that they have made use of such services. Hiring professional writers in the research realm is not always wrong. The context within which an “external” writer is used must be taken into account. Their services are often utilized in the commercial sector, and in certain circumstances, it can be acceptable to do so.

In the academic world, using a writer who was not otherwise involved on a project to generate a manuscript is largely condemned. There are situations where it would be categorically forbidden such as hiring someone to write a thesis or dissertation for a student. Yet, the legitimacy of using writing services becomes murkier when grammatical assistance is being offered. It depends on the degree to which the external person made substantive changes to the work in question. In general, reviewing a manuscript for grammatical purposes is much more innocuous than covertly writing it for another person. It is fairly common, for example, for non-native speakers to seek editorial assistance when drafting a paper in English. Yet, regardless of the context, failing to disclose the involvement of a professional writer is widely considered to be an ethical breach. And hiding the fact that an external writer has been used can lead to allegations of “ghost authorship,” a highly troubling phenomenon that professional organizations and journals deplore. Calls for greater transparency, especially in the biomedical realm (Barbour, 2010), are often voiced in response to it.

## **COMPLEXITIES RESULTING FROM INTERNATIONAL COLLABORATIONS**

The pervasiveness of international research collaborations is having a profound influence on authorship. For example, non-native English speaking researchers, including students and postdocs, can be at a serious disadvantage in terms of writing a publishable paper (Teixeira da Silva, 2011). Reasons for this include that English is normally considered to be the primary, global language of science and engineering. The majority of foreign born researchers and students who attend American universities come from countries where English is not the first language (IIE, 2013), and these individuals have highly varied experiences related to authorship. In addition to poor English writing skills, Heitman and Litewka (2011) outline other factors that can make it difficult for foreign born trainees to understand and adhere to authorship norms. These include that some cultures have a more “permissive” attitude towards plagiarism (Vasconcelos, 2009), and lack policies and standards relating to proper writing practice. What follows is that the lack of immersion in an English writing, educational, or cultural background can serve as a serious barrier in terms of career advancement given the need to publish in prestigious science and engineering journals.

## THE OPAQUENESS OF AUTHOR ORDER

Integrally connected to the issue of who is entitled to be an author is which ordering strategy to select. Not only is there intense pressure in the academic world to have one's name included on as an author, but obtaining a certain position in the ordering scheme tends to carry much weight. Relying on the author order as a means for conveying a person's relative importance to a project is deeply ingrained in research communities. In many fields, graduating, obtaining a job, and earning tenure or a promotion may ultimately hinge on how many "first author" publications are produced. Or, in some fields or regions of world, such as China (Ma and Song, 2013), being the corresponding author is highly valued. As a result, conflicts can emerge as colleagues strive for the most desired position in the author list (Dance, 2012). In general, one wants to avoid being placed in the dreaded "et al." position in the author order.

Alphabetical ordering is fairly common in mathematics and computer science and is also pervasive in economics and management (Waltman, 2012; Marušić et al., 2011). At first glance, this strategy could circumvent disagreements by providing an automatic, default answer for how to arrange the authors. However, in and of itself, alphabetical ordering does not reveal which of the authors made the most significant, or which type of, contribution to a project. Moreover, the researcher with a last name that begins with a letter later on in the alphabet will likely struggle to gain recognition; the natural inclination to refer to a publication by its first author would put that individual at a serious disadvantage. Regardless, the most well-known person in the ordering scheme will likely garner much of the recognition anyway. Furthermore, as the number of authors on a publication grows, the prevalence of alphabetical ordering strategies seems to be declining (Waltman, 2012).

In many fields of science and engineering, the last position in the author list is often deemed to be highly prestigious. Typically, it reveals the person who was the project's main guiding force. However, placing a project director in the last author position is far from a panacea. For example, if multiple research teams, perhaps across different institutions or countries, are involved on a project, it is not always clear who should be entitled to the most prestigious spot in the author list and how to order the remaining individuals who are part of the collaboration. Since many collaborations are multidisciplinary, and now international, in nature, which ordering strategy to use and how to evaluate respective contributions do not lend themselves to obvious solutions.

## FLAWS WITH AUTHORSHIP CRITERIA

Professional organizations and journals normally provide at least some general guidance for authorship determinations. Many offer phrases such as "significant scientific contribution" or "significant intellectual contribution" as the

key, base-level threshold for authorship but largely leave it to the research team to determine internally who has met that criterion. Other entities, including the aforementioned ICMJE and IEEE, articulate a more fully developed set of criteria. Yet, a sizeable amount of room for interpretation in authorship guidelines remains.

Many researchers perceive that they are not receiving their fair share of authorship credit (Seeman and House, 2010). Others fail to adhere to stated authorship criteria, including those provided by the ICMJE (Bates et al., 2004). If one operates in the research world long enough, the number of anecdotal cases about advisors taking credit for their trainees' work certainly mounts. Yet, even if journals more definitively answered who should be an author in particular cases, researchers may not be aware of, nor willing to follow, their standards. For example, a survey of academic chemists indicates that they do not typically refer to journal guidelines when making authorship decisions (House and Seeman, 2010).

Individuals who contribute to manuscript writing might deliberately try to circumvent authorship criteria. Some of these cases involve "ghost authorship" (Matheson, 2011; Barbour, 2010). In other words, instead of being unfairly barred from authorship, some individuals seek to hide their role. Allegedly, having specific and rigorous authorship criteria allows some individuals to rationalize hiding the fact that they have written a paper (Matheson, 2011). The motivation of (deceptively) creating distance between the writer and a publication can be to benefit an employer or other entity (Logdberg, 2011).

## **DIMINISHING ACCOUNTABILITY**

A common thread among the aforementioned problems is that the obfuscation of who should be held accountable for a published work (Attribution and Accountability, 2009; Who Is Accountable, 2007; Timber and Dickersin, 2004; Rennie, 2001; Flanigan et al., 1998). Typical features of large scale collaborative projects, for example, that they can be multidisciplinary and multi-institutional in nature, intensify accountability concerns. A rough equivalent to this is the "problem of many hands," which is often discussed within the context of engineering ethics (Harris et al., 2009, pp. 36-37). Briefly put, the concept refers to the complexity of assigning responsibility for wrongdoing to any one individual when so many people are involved on a project or other activity.

Within recent years, the ICMJE, recognizing how authorship has been manipulated, sought to fortify the definition of the term and its associated responsibilities. The ICMJE revised its authorship guidelines and added a fourth criterion, which states that in order to be an author there must be: "Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved."

While the ICMJE should be commended for promulgating a well-intended “fourth” criterion, fully adhering to it can place unrealistic expectations on each research team member. For example, many undergraduate researchers do not have the authority or expertise to handle the associated responsibilities contained with ICMJE’s criterion. Along these lines, postdoctoral fellows are often at the mercy of a lab director in terms of their professional future and do not always have robust support systems in place to protect them from reprisal if they seek to uphold the “accuracy or integrity” of a project. As the National Postdoctoral Association states, “even in a situation where postdocs may succeed in reporting misconduct, they often still lose since their position and immediate career future may depend upon the PI or lab that has engaged in misconduct.” The power differential between junior and seniors researchers is hard to ignore. Furthermore, one collaborator may effectively have no way of knowing how another’s data were obtained or what they fully mean. For example, a biochemist collaborating with an X-ray crystallographer or an electron microscopist might not be able to, or struggle to, appreciate the field-specific nuances of the other person’s work.

In short, the “fourth” criterion may not be reasonable or feasible for all research team members. However, severing the integral connection between authorship and accountability must not occur (Shamoo and Resnik, 2009, p. 102). Clearly, each researcher should be responsible for what he or she has actually done. Every author, especially the corresponding author or the project’s “guarantor,” must perform due diligence as to the integrity of all of the project’s components. But arguably, authors should not be the principal responsible party for portions of a project that are outside their area of competence or expertise.

## REVISITING THE CONTRIBUTOR MODEL

Resnik (1997) was among the first to suggest the contributor model as a solution to the ill-defined authorship. Ongoing discussions of different contributor models followed (Shamoo and Resnik, 2003, pp. 53-54; Rennie et al., 1997). While there are variations of contributor models, the unifying theme among them is creating a more meaningful opportunity to delineate each person’s range of tasks. “As well as preventing accurate attribution and appropriate allocation of credit, the lack of transparency of contribution obscures accountability” (IWCSA Report, 2012). Thus, the overarching intent is to make more transparent who is primarily responsible for each specific aspect of a research project.

Many professional journals, including those affiliated with Cambridge University, encourage the use of a contributor model. The *Nature* journals (2014) require the individuals listed on submitted manuscripts to provide

“author contributions statements.” The ICJME offers a distinction between “authors” and “non-author contributors” with those who fulfill some, but not all, of its authorship criteria falling into the latter category. The *British Medical Journal (BMJ)* distinguishes “authors” from “contributors” but indicates that the two categories can overlap. According to *BMJ*, “we list contributors (some of whom may not be included as authors) at the end of the paper, giving details of who did what in planning, conducting, and reporting the work.” Similarly, the *Journal of the American Medical Association (JAMA, 2014)* asks authors to describe their respective contributions within the “Acknowledgement section” towards the end of a submitted manuscript. *Nature Cell Biology* requires each author to provide a contribution statement and stipulates that a senior researcher from each research team is responsible for that team’s work (2014, p. 4). In addition, the presumption is that an article’s senior author is responsible for its entirety.

## A STRATEGY FOR INDICATING CONTRIBUTIONS

Indicating each researcher’s involvement on a project could be accomplished through a slew of methods (Allen et al., 2014). For example, a collection of journal editors and others created a “14-role taxonomy” that could enable researchers to delineate their specific tasks (IWCSA Report, 2012). Following Resnik (1997) and Rennie and colleagues (1997), each collaborator on a research team would select from a list of designations which particular roles he or she filled on a project and that information would be shared within the research team’s publications or supplemental materials. Designations may need to be crafted in a more “fine-grained” manner by adding terms such as “primary” and “secondary.” Furthermore, as Resnik recommends (1997, p. 241), the types of designations should be tailored to the disciplines involved on a project.

While proposals have been voiced to “scrap” the term authorship entirely (Rennie, 1997, p. 258; Rennie et al., 1997), we recommend retaining the designator “author” and reserving it only for those who directly participate in the writing process. This harkens back to a more traditional definition of an author, which is still prevalent colloquially, in some disciplines, and in the realm of book publishing. The aim is to dissipate the inherent ambiguity associated with the term, especially when working across disciplinary lines, and to establish some level of consistency in the term’s use across different contexts. The more specific designator “corresponding author” could remain intact, indicating who has taken the primary responsibility for communication-related tasks.

In addition, a contributor taxonomy (e.g., “author,” “data analyst,” “guarantor,” etc.) could be supplemented with indicators used to highlight which specific portions of a project are connected to which particular individuals or

groups. In other words, along with explaining everyone's individual role on a project, each main section of a manuscript could contain information that relays to the audience who was primarily involved in performing the relevant work (e.g., Research Team A performed the mass spectrometry; Research Team B performed the statistical analysis, etc.). This strategy is especially important for multi-site projects where collaborators may be unable to scrutinize each other's work directly.

## CONCERNS ABOUT THE CONTRIBUTOR MODEL

The contributor model certainly does not resolve all of the authorship-related problems described herein. The success and effectiveness of the approach largely hinges on the willingness of researchers to be intellectually honest about their roles. There will continue to be at least some who try to take more credit than is warranted while describing their involvement on a project. As Friedman astutely points out (1997), a contributor model is not an elixir for dishonesty and for abuses emerging from power inequities. For example, a colleague might indicate being a data analyst when that person's participation in the activity was only tangential or non-existent. Furthermore, two or more individuals could claim credit for the same task (for example, data collection) and strongly disagree about whose contribution was more significant. In response to issues of this type, Clement (2014) describes a system for quantifying contribution level; yet, it is hard to imagine that any system which requires each person to quantify effort numerically would prevent conflicts.

Moreover, we cannot discount the possibility that a problem afflicting authorship could carry over to the contributor model. Over the years, an expanding and perhaps "watered-down" definition of authorship has emerged. Being a "contributor" runs an equivalent risk (i.e., the inclusion of anyone who was even remotely involved on a project). What follows is the potential dilution of the value of being mentioned on a publication while continuing to obscure who should be held accountable for the relevant work. As Smith and Williams-Jones claim, "Granting authorship to everyone who enables research would be an unrealistic and extreme extension of the notion of authorship" (2012, p. 204). It would be similarly unpalatable if contributorship went in this direction.

Even if a contributor model gains traction, an unresolved issue is how to more fairly cite or reference a research team's work after publication. Unfortunately, shorthand conventions such as referring to a paper by the first or senior author's last name will be hard to replace. Perhaps the merits of using a unique identifier for the research team can be explored, but one can readily imagine how cumbersome that could be. Academic and research communities would undoubtedly be reticent to implement a new or modified credit allocation strategy (Rennie et al., 1997, p. 584; Resnik, 1997, p. 241). While

counting “first author” publications is obviously an imperfect way to evaluate someone’s career, employers and others do value its simplicity. In the interim, holding to standard citation conventions may be necessary. Yet, adhering to a contributor model will hopefully mitigate the natural inclination to overvalue the efforts of a subset of the research team and ignore what the other members have accomplished. In principle, the audience will have access to more nuanced information as well.

## **IN DEFENSE OF THE CONTRIBUTOR MODEL**

The contributor model’s alleged shortcomings are ones already plaguing current authorship practice. Yet, a crucial virtue it possesses over a standard authorship approach is that a fuller range of options for listing one’s role on a project is available. This advantage could lessen the temptation to ignore or undervalue a colleague’s worth to a project. A standard approach to authorship has the key inherent failing of being too “bifurcated.” In other words, there are usually only two main options to select between: (1) the all-important, perhaps career deciding, placement of a person’s name on the author list or (2) not doing so, which more or less makes that person’s respective contribution vanish. The possible consolation prize associated with the latter option is being mentioned in an acknowledgments section, which rarely carries sufficient weight to advance one’s career. In short, authorship inclusion and exclusion decisions place too much pressure on each individual researcher, especially when at a career crossroads. Unfortunately, the abuse and manipulation of an author list is not surprising considering how important getting one’s name on it tends to be.

It might be overly optimistic, and arguably naïve, but the contributor model could alleviate at least some of the conflict relating to author order since in principle, decoding each person’s tasks should be easier. The overemphasis on author order in research communities creates an environment ripe for disagreements and frustration. For example, a graduate student who has been working on the same project for years with another student should not have to fret over whether which one of them is going to be listed as first author (or even whether they both are going to receive authorship credit). Author lists and order have carried an undue amount of significance for far too long.

If the traditional author credit system is modified, this would have spillover effects to how individuals are evaluated for career advancement purposes. There are initiatives in place that could be useful in this regard. The practical barriers to describing each collaborator’s role may be easing in part because of technological advances (Frische, 2012). For example, ORCID is an attempt to connect researchers to the collection of activities undertaken during the course of their career. ORCID’s strategy involves providing each researcher

with a unique “digital identifier” so that credit for respective accomplishments is obtained. Since more options would be available under a contributor model for indicating a person’s role on a project, deciphering who actually participated in the writing process should become more transparent, information which may be of value to current and prospective employers.

A contributor model could also reveal “ghost” authors along with other troubling attribution practices (Wager, 2009, p. 112). Along these lines, the manner in which research team members are required by journals to describe their contributions could have an impact on whether and how “honorary” authors are listed on a manuscript (Bates et al., 2004). Moreover, with its emphasis on transparency, the contributor model may allow for a more effective and measured application of ICMJE’s fourth criterion. In short, those who indicate more substantive roles on a project, oftentimes referred to as “guarantors,” carry with them more accountability for it.

## LESSONS FROM THE PATENT REALM

In the effort to unearth potential remedies for authorship problems, reflecting on the patent system and inventorship may be useful. Distinct differences exist between being an “author” of a work and an “inventor” on a patent. An authorship list and an inventor list will not always match for the same work product; while the discrepancy can have a legitimate explanation, it can also occur for dubious reasons (Lissoni et al., 2013). Moreover, according to Haeussler and Sauermann, “In contrast to the relatively ambiguous formal criteria for authorship, formal definitions of inventorship are clearer and are typically codified in law” (2013, p. 690). Yet, measures used within the patent system could still provide insight in terms of how to fortify authorship practices.

Roughly put, the principal criterion for being an inventor on a patent is contributing to the conception of the idea underlying the patent (Patent Lens). As Lissoni et al., state, “each person named on a patent must have contributed to the conception step in the invention (as defined by the claims)” (2013, p. 52). If one or more inventor is not listed on a patent or a non-inventor is listed as an inventor, the patent can be invalidated. Dishonest acts or statements relating to a patent can result in the same outcome (Degnan and Huskey, 2006). Following analogous logic in the authorship realm could reduce the associated problems assuming that an effective enforcement mechanism is implemented for violations. In other words, if the exclusion of a person who should be entitled to authorship or the inclusion of someone who should not be invalidates the resulting publication, research teams would be much more reticent to manipulate an author list. We are not naïve to assume that abuse can be fully prevented; rather, the overarching goal is to decrease the frequency of its occurrence.

Of course, creating such a process is not simple. In the realm of patents, the courts are relied on to some degree to handle disputes among inventors. For obvious reasons, including the associated costs, resorting to legal means to enforce the honesty of authorship decision-making would be unwise. The other main options would seemingly be to rely on employers, funding sources, publishers, or some combination thereof to handle authorship disputes. Each of these options has serious shortcomings, but the power that publishers can exert to remove a paper from the literature makes them a focal point for any system of enforcement. A key obstacle to overcome is the natural reluctance of journals to retract their own articles. Also, journal editors may not have access to sufficient “insider” information in order to resolve authorship conflicts (Wager, 2009, p. 111). However if authorship guidelines, such as “The author list should include all appropriate researchers and no others” (*Nature*, 2014), are going to carry real teeth and are not just viewed as hallow words, then some level of enforcement by publication outlets is necessary.

## CONCLUSION AND RECOMMENDATIONS

For many years now, standard authorship practices in research communities have been riddled with serious problems. A researcher may only have a cursory level of participation on a project, for instance, but when the collection of names appears on an author list, the audience may not be able to distinguish between that person’s role and someone who had a more substantive contribution. Readers and others are largely left to (inaccurately) infer what transpired on a project from the author order. A potential avenue for addressing this and other related concerns is to more fully implement a contributor model in the research realm.

In short, published works should list all those who contributed to a research project and/or to its written description. Strategies such as the use of an asterisk with a corresponding footnote could direct the attention of the reader to a detailed explanation of each person’s respective tasks. The intended consequence of this is that both contributors and authors (with names that may fall into both categories) should receive the actual credit, acknowledgment, and accountability for their respective content and effort. What is of fundamental importance is that any person listed as a contributor must take accountability for at least a relevant portion of the project (corresponding at a minimum to the portion for which that individual wants to receive credit). The readers of such information contained in a publication will have at their disposal all of the research team member names along with their respective roles.

Transparency is upheld in part by revealing who has written a manuscript in an age when the term “author” has gained an expansive, ambiguous, and in many ways, diluted meaning. Furthermore, the use of “author” label could

reveal which of the individuals listed *only contributed* to a project's written description and not to other essential tasks (such as formulating the research problem, data collection, etc.). This enables the audience to more fully weigh the value of drafting the phrasing and terminology used to describe a project and whether that is a skill worthy of recognition.

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