Researchers' perceptions of ethical authorship distribution in collaborative research teams

Elise Smith[1], **Bryn Williams-Jones**[2], **Zubin Master**[3], **Vincent Larivière**[4], **Cassidy R. Sugimoto**[5], **Adèle Paul-Hus**[4], **Min Shi**[1], **Elena Diller**[1,7], **Katie Caudle**[1,6], **David B. Resnik**[1]

[1]National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, NC, USA

[2]Bioethics Program, School of Public Health, University of Montreal, Montreal, QC, Canada

[3]Biomedical Ethics Research Program and Center for Regenerative Medicine, Mayo Clinic, 200 First Street, SW, Rochester, MN, USA

[4]School of Library and Information Science, University of Montreal, Montreal, QC, Canada.

[5]School of Informatics, Computing and Engineering, Indiana University Bloomington, Bloomington, IN, USA

[6]Department of Biological Sciences, Central Methodist University, Fayette, MO, USA

[7]Medical College of Georgia, Augusta University, Augusta, USA

Abstract

Authorship is commonly used as the basis for the measurement of research productivity. It influences career progression and rewards, making it a valued commodity in a competitive scientific environment. To better understand authorship practices amongst collaborative teams, this study surveyed authors on collaborative journal articles published between 2011-2015. Of the 8364 respondents, 1408 responded to the final open-ended question, which solicited additional comments or remarks regarding the fair distribution of authorship in research teams. This paper presents the analysis of these comments, categorized into four main themes: 1) disagreements, 2) questionable behavior, 3) external influences regarding authorship, and 4) values promoted by researchers. Results suggest that some respondents find ways to effectively manage disagreements in a collegial fashion. Conversely, others explain how distribution of authorship can become a "blood sport" or a "horror story" which can negatively affect researchers' wellbeing, scientific productivity and integrity. Researchers fear authorship discussions and often try to avoid openly

discussing the situation which can strain team interactions. Unethical conduct is more likely to result from deceit, favoritism, and questionable mentorship and may become more egregious when there is constant bullying and discrimination. Although values of collegiality, transparency and fairness were promoted by researchers, rank and need for success often overpowered ethical decision-making. This research provides new insight into contextual specificities related to fair authorship distribution that can be instrumental in developing applicable training tools to identify, prevent, and mitigate authorship disagreement.

Keywords

authorship; collaboration; ethics; misbehavior; professional ethics

Introduction

Authorship is at the heart of the reward system of science and serves as the basis for decisions regarding funding, career advancement, salary, and prizes. Authorship also enhances a researcher's recognition and credibility, and increases opportunities for further research and collaboration in a competitive research environment. Authorship has been called the "coin of the realm" (T. Babor, Morisano, et al. 2017), the "coin of scholarship" (Ioannidis et al. 2018) and a form of "symbolic capital" (Bourdieu 2004). The more an individual is named as an author on scholarly works, the greater the credibility they gain as a scientist or expert on a specific topic of research (Latour and Woolgar 1979). With credibility comes responsibility and ensuing accountability for the scientific work. Indeed, as is commonly mentioned in responsible conduct of research (RCR) training and education, authorship is based on both fair credit and ensuring accountability for one's work (Biagioli 1998; Shamoo and Resnik 2015).

While the symbolism linked to authorship might seem fairly straightforward, the attribution of authorship is more complex. First, research is increasingly collaborative, and teams are larger and more prevalent in fields such as the biomedical sciences and high energy physics than in the social sciences and humanities (Larivière et al. 2006; Wuchty et al. 2007). Second, increasingly, teams are located in different research institutions internationally with diverse norms and cultures (Gazni et al. 2012). Third, many research collaborations are becoming multidisciplinary and transdisciplinary, including researchers from different fields who may attribute a different value to various types of contributions (Smith and Williams-Jones 2012). Collaboration may enable greater sharing of skills, knowledge, materials, and funding; however, authorship distribution in research collaborations remains challenging and may result in significant disagreements (Nylenna et al. 2014; Okonta and Rossouw 2013; Smith and Williams-Jones 2012).

Almost all guidelines regarding the RCR and/or publication ethics explain that all authors must have "contributed significantly" to part of the research study (Council of Science Editors (CSE) 2012). Contribution in science is defined according to a complex set of variables including time spent, skills required, effort involved, and the quality, type and novelty of the contribution. A study of medical journals suggests that the bigger the team the

less likely authors are to have respected guidelines that are based on "substantial contribution" criteria, i.e., with some authors having only made more peripheral contributions such as administration or funding (Mali ki et al. 2012). It is generally recognized that many researchers are not aware of authorship guidelines, may interpret them selectively, or may choose to intentionally ignore them (Matheson 2011; Pignatelli 2005).

To further complicate matters, researchers are likely to rank contributions according to their disciplinary culture, institutional norms or group dynamics. For example, in the biomedical sciences, the first author has often contributed the most while the last had a supervisory role – and both authors assume some level of leadership over the project (Larivière et al. 2016). In the social sciences and humanities, where teams are typically smaller and less hierarchical, the last author could have contributed the least. In the biosciences and medical research fields, there is a significant rise in equal contributors creating co-first-authors (Conte et al. 2013). In high energy physics and genetics, there is a concept of hyperauthorship where papers may exceed hundreds of authors (Cronin 2001). In economics and mathematics, authorship norms include placing researchers in alphabetical order (Waltman 2012). As noted by Mongeon and colleagues, alphabetical order may be used in very large medical research teams to represent middle authors who contribute similarly (Mongeon et al. 2017).

Empirical studies on authorship generally apply to one specific field or discipline of research. In 2011, Maruši and colleagues conducted a meta-analysis of authorship distribution studies. Of 118 studies, 53% were surveys and 27% were descriptive, and most were limited to the health or social sciences (Maruši et al. 2011); and 43.2% of these studies discussed ethics regarding authorship practices. The conceptual and empirical literature suggests that giving authorship to undeserving authors – often named as "guest", "gift", "prestige" or "honorary" authorship – remains one of the most prevalent problems (Al-Herz et al. 2014; Flanagin et al. 1998; Wislar et al. 2011). Honorary authorship has been a central part of the debate linked to "coercive authorship" in which an individual in power pressures a junior colleague to be named as an author when they did not contribute substantially (Greenland and Fontanarosa 2012). Interestingly, a recent qualitative study found a tendency within multidisciplinary environmental science teams to be very inclusive in distributing authorship even when the sufficiency of the contribution might be questionable; according to the authors of the study this could lead to more honorary practices (Elliott et al. 2017). Another concern is unintentionally or intentionally excluding deserving authors, i.e., ghost authorship; this term is also used for the intentional exclusion of names of researchers who have financial ties to industry, thus making the research seem less industry-driven or more neutral, and thus a way to hide conflicts of interest (Flanagin et al. 1998; Sismondo 2009). Reasons for such practices include power relations, feelings of obligation, crediting past and future relationships, and team responsibility (Bhopal et al. 1997; Claxton 2005; Meyer and McMahon 2004).

Recent literature has argued that current norms of authorship recognition are insufficiently transparent regarding the work completed by each author (Baskin 2014; Hayter et al. 2013; Rennie 1997, 2001). The notion of contributorship was proposed as a way to clarify which individuals contributed to which task (e.g., study design, data collection, experimentation,

data analysis, writing of the manuscript). Empirical studies of declared contributions of authors in *PLOS* and *PNAS* journals found that first and last authors often have the most types of contributions (Larivière et al. 2016; Sauermann and Haeussler 2017). However, as suggested by Sauermann and Haeussler, a significant share of practices deviate from such conventions; these include cases in which the last author contributes less than middle authors, or in gift or ghost authorship (Sauermann and Haeussler 2017).

Researchers may accept that authorship should be distributed in a *fair* manner; however, the notion of fairness itself is not applied in a consistent manner within academia. It is also conceptually sound and reasonable to consider other principles that enable ethical authorship distribution, including: *merit* based on work completed, *fair recognition* based on impartiality and nondiscrimination, *transparency* throughout the research process and *collegiality* of team members in order to facilitate agreement regarding authorship (Smith 2017). Louis and colleagues (2008) conducted a qualitative study amongst researchers in the lab sciences and showed that fairness was accompanied by notions of reciprocity and sponsorship. Scholars have also considered processes and procedures to promote ongoing discussion and team meetings of researchers regarding the specific attribution of tasks and relative contributions from the onset as well as throughout the research process (Clement 2014; Smith and Master 2017). However, one of the central challenges with guidance and practical ethics has always been in its effective application to complex and diversified research systems and collaborations. For example, if there are disagreements regarding authorship (naming or ordering), a team of five individuals may be able to discuss the issue in collegial fashion and *fairly* find consensus. However, in an international team of more than one hundred individuals, open conversation may be simply impractical and therefore unrealistic.

In order to better understand the manner in which authorship is distributed in collaborative scientific fields, institutions and countries, we conducted an international survey of authors who had participated in multi-author publications. Researchers were queried about procedures, practices and guidelines related to naming and ordering of authors as well as the incidence of questionable or unethical behaviors associated with authorship attribution. The quantitative analysis of our survey project (Smith et al. 2019), indicates that almost half of researchers who responded had experienced an authorship disagreement regarding naming (46.6%) and ordering of authors (37.9%). As a result of disagreements, researchers reported having witnessed or been personally involved in problematic behavior (e.g., fraud, sabotage, hostility). Further, unethical conduct related to authorship was more diverse and went beyond gift or ghost authorship, subjects that have been the focus of the literature on unethical authorship. In this paper, we present the results of our study of the ethical subtleties mentioned by researchers in their qualitative comments.

Methods

An inductive approach was used to provide knowledge and meaning surrounding the topic of authorship distribution in team research. Qualitative Content Analysis (QCA) allowed a systematic approach, flexible application and the reduction of large amounts of data (Schreier 2012, p. 5). This data-lead approach is typical in the open coding stages of

grounded theory (Creswell 2009; Strauss and Corbin 1990); however in this specific study we did not aim to develop a full theory but rather to describe concepts of ethical importance suggested by research participants.

Using the Web of Science (which indexes meta-data from published work in all fields of research), we generated a sample of more than 103,297 individual researchers who had published multi-authored journal articles between 2011 and 2015. The sample was stratified by level of interdisciplinarity: a score was developed based on the disciplinary diversity of references cited in their scholarly papers. The score was then divided into five categories – A, B, C, D, E – with letters at the beginning of the alphabet being most disciplinary while those at the end being more multidisciplinary. In the survey, researchers were asked about their field, gender and rank. The survey was written in English and developed based on issues in the literature, preliminary qualitative interviews, as well as the experience of our team of multidisciplinary researchers; the survey was pre-tested to ensure that the questions were understandable and clear to researchers from different fields (for more information on sampling and survey development see (Smith et al. 2019).

A total of 8,364 individuals responded. To gain a better understanding of perceptions about authorship, researchers were asked the following question at the end of the survey: "Do you have any final comments or remarks regarding the fair distribution of authorship in team research?" A total of 1,408 researchers answered this qualitative question. The volume of the responses was unanticipated: while some respondents wrote only a few words or sentences, others wrote multiple paragraphs (up to 2,054 characters of text). The volume of the responses and the richness of the experiences presented thus encouraged our team to analyze this qualitative data in detail. Table 1 shows information about the participants who responded.

The qualitative results of the survey were subjected to QCA (Schreier 2012). Two individual coders (ED and KC) inductively analyzed the data for emergent themes that were validated through careful deliberation and consensus. Coders ED and KC were new to the topic; this was considered an asset in that they could interpret the qualitative content without any prior bias or undue influence. Coders spent two weeks reading responses and identifying recurring themes that could be used to systematically define and structure content. Since comments were generally short, ranging from one word to a brief paragraph (2,054 characters), they were identified as the unit of analysis. In other words, coding was applied by identifying presence or absence of codes for the entire comment. As is common during inductive qualitative research, coders worked alternatively with the data and the codes to develop a coding framework (Creswell 2009, pp. 173–202). The coders used various methods to promote validity; they spent three months immersed in the data, engaged in peer debriefing once or twice a week, and completed three pilot tests on subsets of data to then review key issues (Schreier 2012).

Qualitative responses were coded in *Dedoose* Version 7.0.23, a mixed-methods analysis software. To ensure that the agreement of coders was not simply the result of chance, all codes were evaluated based on Cohen's Kappa inter-rater reliability in SPSS (Version 21). The Kappa scores ranged from of 0.63-0.80 (p<0.01) which is generally considered as

substantial agreement (McHugh 2012). Kappa scores for each theme are presented independently in supplementary material (Annex A). The coders resolved most disagreements amongst themselves; 19 codes remained unsettled, and thus the principal investigator (ES) stepped in to make the final decision.

To better understand the group and context in which themes were discussed, a likelihood-ratio test was used to compare the goodness of fit between the model under the null hypothesis of no association and the alternative model. These quantitative results are not generalizable and were simply used to better understand the population that commented on specific themes. Logistic regression was performed to evaluate whether rank, gender, interdisciplinarity and field were associated with thematic codes. Each thematic code was in turn used as the response variable and rank, gender, interdisciplinarity and field as covariates in the regression model.

Results

Our qualitative analysis yielded a total of seven thematic codes or groupings; only four of those groupings were considered relevant to this study since they are linked to ethics and serve to answer the research question. Table 2 includes theme descriptions and count for this specific study; a wider analysis with more themes is included in supplementary materials (Annex B). Finally, we also excluded the code "other" since some comments were either 1) too vague to be meaningful, 2) mentioned something along the lines of "I have no other comment" or 3) made comments or suggestions regarding the survey or the methodology. In order to identify groups that were more likely to discuss specific codes, Table 3 shows the likelihood of rank, gender, field and multidisciplinarity to influence the group of respondents. The Chi-square statistics and P-values of the likelihood ratio tests are shown in Table 3. This statistical analysis is not used for inductive purposes but rather to identify if certain themes were only discussed by individuals of a specific group based on gender, rank, discipline, etc.

1. Authorship Disagreements

A total of 156 individuals (11.8% of the sample) discussed the notion of disagreement. No subgroups (based on rank, gender, field or multidisciplinary) were statistically significantly prominent in this sample, as shown in row number 1 of Table 3.

Some respondents referred to authorship disagreements as "horror stories" (ID:7034); they also mentioned that disagreements resulted in hard feelings such as anger and jealousy, intense disruption within the research process, and a significant waste of time. However, other respondents acknowledged the presence of disagreement but managed the situation so that it was not particularly hurtful to the individuals involved. Reasons given for disagreements included: diverging views about the concept of authorship, different publication cultures, lack of knowledge regarding authorship, and use of different guidelines. Cases of egregious disagreements seem to involve overtly unfair and unethical distribution; these types of disagreement also fall within the "unethical or questionable behavior" code and will be further addressed in that section.

Respondents explained different ways of valuing contribution that may lead to disagreements. One individual suggested, "Older established experimentalists are fairer in their inclusive practices for authorship as it is easier to identify contributions of analysis and data. Theorists in general regardless of age are more 'stingy' with their sharing of authorship, even (as especially) when the papers compare their theory/computational results to data taken by experimentalist colleagues." (ID:160) However, comparing or assessing types of contributions seemed to be more straightforward than comparing contributions that evolve over the duration of a project. Many comments implied that some team members lacked consistency in their contribution, which necessitated changes or adjustments to the project plan: "Sometimes a researcher participates initially and then stops attending meetings. Or someone does not respond in a timely manner to a requirement for feedback on an article. It is difficult to decide if one should eliminate the person totally from the article." (ID:1317) In other words, at the beginig of the project, individuals may participate and agree upon an estimate or plan for the division of labor and the attribution of authorship. But in the event that project requirements evolve and tasks and responsibilities change, individuals may not receive the expected recognition and so disagreements may arise.

Respondents reported that some disagreements were due to personality traits or specific individual behaviors such as dishonesty, ignorance, or narcissism. Others considered friction or interpersonal tensions between individuals to be the main reasons for disputes and suggested that disagreements were simply a matter of individuals acting in bad faith when they disliked one another: "Everyone knows how much was contributed and by whom. The only case(s) where I witnessed tension and arguing was when two researchers in our team did not get along in general terms. So, they essentially fought because it was a pissing contest." (ID:2007).

Some disagreements took place in situations when there was seemingly no fair outcome possible. For example, although a footnote may stipulate that two individuals contributed equally, one author may still receive more recognition given the common practice of giving prestige to first authors as well as the reference style 'first author et al.'. One respondent mentioned that to resolve an impasse, "sometimes a simple operation like coin-tossing may need to be used after creating consensus!" (ID:1002) The underlying rationale for the coin-toss is that the team members recognize situations in which, all things being equal, there is not one person who deserves more credit than another and unfortunately no sure way of conveying this in the distribution of authorship. So, instead of creating a hostile environment, it may be better to let the even odds of a coin toss prevail.

Many respondents identified contextual factors that contribute to disagreements. For example, one researcher mentioned that the increasing size of research teams and the ability to mainly give credit to first and last author results in fewer people being recognized. Some individuals whole-heartedly disagreed with the overinclusion and inflation of author numbers; they considered it unfair to individuals who did the work. A few researchers mentioned that in the academic context where one "needs" authorship to gain funding, individuals completing funding applications or renewing funding will typically obtain more authorship recognition regardless of how much work they actually completed.

Circumstances involving a graduate student completing their PhD were seen as particularly contentious. Some respondents suggested that the mentoring and guidance provided by a PI or a dissertation committee is often a substantial contribution and should be recognized for authorship. However, others maintained that mentorship should be excluded as a contribution to research or that it was simply not substantial enough to achieve authorship status. One respondent stated,

> I strongly reject the science-based practice of dissertation supervisors claiming co-authorship with their graduate students. This is our job – to teach them how to research, analyze and write. Several of my students (all successful academics now) came to conclusions in their research with which I disagreed. But, the end-product was their own and they defended successfully. They played as it were their own concerto. On the other hand, co-authors are equal peers. We take joint responsibility for our work.

(ID:6122)

This researcher argued that deciding whether to include a supervisor as an author on a student's work was really about whether it constitutes "substantial contribution". The primary role of a supervisor as mentor is to provide guidance to junior scholars so that they can become independent and ultimately become authors in their own right.

Nevertheless, if some supervisors put their name on their students' work, it is only logical to expect that in order to 'stay in the game' and be competitive, others will follow. Indeed, a major reason for authorship disagreements is the fierce competition in science. As one respondent stated, "The competitive rat race breeds conflict among researchers. Perhaps we need to end the mass hysteria of publication and focus more on less (quality) than on more (too many dead trees)" (ID:243) Conversely, another individual considered the competitive and collaborative system to be one that enables fair behavior since most individuals would rather collaborate with fair individuals,

> Most scientists work in a small community and collaborate extensively within an even smaller subset, and whatever disagreements may inevitably arise, there is always the clear understanding that if everybody 'plays fair', everyone wins, and anybody who screws his colleagues over (or uses their influence to add unwarranted authors) will soon find themselves with fewer and fewer willing collaborators. Overall, I think the system works from the researcher end of things.

(ID:5130)

Although systemic self-regulation of fairness seems logical, it does not appear to be a widely shared experience. Some respondents acknowledged that their research team managed to resolve disagreements amicably in such a way that everyone agreed with the outcome. Many researchers recognized that authorship management and disagreement mitigation are dependent upon the researcher's ability to talk through issues and adequately smooth out disagreements. Respondents considered this as a question of responsible mentorship. In this respect, some respondents reported that their teams had developed guidance to promote ethics, "Our teams and faculty have developed policies, handbooks, and tools (e.g., manuscript maps) that help us to be comfortable understanding the criteria for authorship,

and processes to discuss authorship and resolve conflict" (ID:1262). One respondent mentioned that authorship rules should be built into memorandums of understandings and research protocols to serve as a type of contractual agreement. Some researchers also pointed out that given the frequency of authorship disagreements, it is helpful to have a third party (or neutral individuals) help with difficult deliberations.

Some respondents found authorship discussions particularly difficult. For example, one researcher reported that his attempt to discuss authorship in an open fashion had been met with "major hostile or defensive responses" (ID:1482). Another respondent suggested that talking about authorship is a taboo, but one that has to be overcome, "Talking about co-authorship is like talking about sex. It might be uncomfortable but it has to be done. Open discussions avoid misunderstandings. And it gets easier the more you do it" (ID:1533). Conversely, some individuals tried to discuss authorship only to see a negative outcome. After disagreements regarding authorship, respondents tended to avoid open discussion for fear that it could actually create more issues and animosity; one researcher mentioned that in many cases "it is not worth the fight" (ID:156). However, the repression or absence of communication can be very difficult to handle for some researchers, and can foster further resentment and unethical behavior. One respondent noted, "I have observed colleagues become irrational when communication has broken down leading to accusations of theft of data, etc." (ID:86)

Others mentioned that they worked in an environment where fear and a degree of hostility prohibited them from having open and honest conversations,

> Team research (at least in our group) is driven by fear. The full professor decides on the promotion of researchers, who stays and who leaves. The full professor does not usually participate in the research (and he couldn't if he'd like to, because of his lack of knowledge on the field). When the paper is sent, he decides on authors and their order, new authors are usually added who had no participation at all in the research and who never ever read the paper. Criticism of this behavior leads to you being "marked" in the group, and even to the sabotage of your work (including the confiscation of the measuring tools you need for your research). As fear drives everything, people usually shut up and accept the situation, while the smartest and brightest people tend to leave when they understand the game, thus impoverishing the research group. As it is academic rank what decides everything, people devote their efforts to building good relationships with full professors rather than to building good research lines.

(ID:306)

In order to avoid disagreements altogether, some respondents selectively chose teams so as to avoid disagreement, "There is a self-selection process. I am writing papers with researchers, who agree with my understanding, how research is organized (and authorship is solved)" (ID:92). Although avoiding disagreement does seem sensible, some researchers appeared to take prevention to an extreme by only collaborating with like-minded people, with disappointing outcomes,

> I invariably associate research with multiple authors/researchers with some of the most uninspiring and least interesting research. Sadly, when multiple authors/ researchers are selected, we tend to pick folks who agree with us (and that makes the research quite dull). But who will select researchers who will disagree with you, even though the research might hold more promise? There is also an element of dishonesty in presenting multiple authors from different universities to create the illusion of cross-disciplinarity, etc. It is competition that drives such dishonesty.

> (ID:87)

This very candid account speaks to the fact that researchers are often selected because of their capacity to agree and follow orders, not for their ability to debate ideas, challenge the status quo and innovate. This conservative view may indeed promote the creation of teams that work well together and avoid the risks linked to disagreements such as hostility, bullying, retaliation or even sabotage. While reducing hostility in a team may be good for science, extending this notion to the point of reducing diversity and open debate may have a negative effect on innovation.

2. Unethical or Questionable Practices

This study defines ethical issues and questionable practices derived from the respondents' explicit observations of wrongdoing or what could be contrasted with sound ethical practices. Coders were careful not to infer or inject their own perceptions as to what constitutes 'right or wrong' but to capture only the views of the respondents. Coders identified 308 comments about unethical practices (21.8% of the respondents). More researchers from a lower rank discussed unethical practices when compared to higher ranked researchers: 31% of researchers "in training", 25% of individuals in "early career", 22% of researcher in mid-career and 18% of researchers with tenure. When considering gender, 27% of women discussed this topic compared to 18% of men, a small but significant difference. Individuals in multidisciplinary teams were also more inclined to comment on unethical practices. However, there was no discernable difference in the amount of responses from different fields of research. This does not mean that such individuals were more or less likely to be involved in unethical behavior; it simply shows that the group discussing this topic is different in representation than the total sample.

Researchers expressed strong opinions about honorary authorship. One researcher labelled the phenomenon of overinclusion as free-riding:

> The main issue I've had is with free-riding. In order to not offend anyone on the large team, everyone is added as an author. Most of these authors are free-riding, that is, contributing little to the project and nothing to the manuscript (I think these people should be acknowledged but not named as authors). (…) The other factor is the national research council which evaluates authors based on the quantity of publications. This point system motivates swapping authorship: you can free ride as an author on my paper and next time you let me free-ride.

> (ID:43)

This mechanism of evaluation is a generalized phenomenon used by many funding agencies and universities to evaluate productivity thus increasing "free-riding". Conversely, many researchers suggested that being excluded as an author had a more significant negative impact on an individual's self-worth than overinclusion. Individuals who believed that they had been unfairly excluded expressed feeling very hurt and unappreciated.

Some respondents commented that the development of overarching, generally accepted and enforceable guidelines would help to distribute authorship in an ethical fashion. At the moment, norms and cultures differ according to research field, discipline, institution and country and they all influence, to differing extents, what is deemed to be ethical or unethical. One respondent articulated this normative confusion as follows: "The main ethical and practical problems regarding fair distribution of authorship arise from differences between national or other academic cultures and practices and from differences between practice in different distributions. There are also cases of behavior which may be considered unfair in some contributions but largely ethical or normal practice in others." (ID:2755)

In certain contexts where guidelines are applied, respondents have remarked that researchers seem to be using them to exclude individuals who have contributed substantially. One respondent stated that "One huge issue that I have seen is the criteria of 'approval of final version of manuscript' being abused to remove authors" (ID:268). In other words, individuals may contribute substantially throughout the paper but are not given the final draft to read and comment. As such, they have not agreed with the final draft, cannot take responsibility for the work and are removed as an author. Another respondent suggested that "Guidance is great but people can use it to justify improper authorship naming and order using subjective criteria, biased perceptions of contributions, etc." (ID:1482) Yet, another respondent explained how and why manipulation or selective use of guidelines occurs:

> What is important to highlight in this research is the basic fact about human behaviors that is a tendency of people to imitate their compliance with ethics, guidelines, laws, etc. As a consequence, in real-life situations, it is very common to mask unethical actions with artificial and superficial arguments about importance of something that is, under impartial examination, not important at all. This lies at the core of abusing of ethics in publishing from so many team leaders. Opposing the practice of the above imitation and unethical actions is difficult as the balance of power and disciplinary guidelines in a research institution are on the side of those who like 'catching fish in muddy waters'.

> (ID:354)

This respondent was not the only one to consider power imbalances as the main cause of many actions deemed unethical. Another reported the following case: "this individual would bully his doctoral students regarding authorship and would even have them sign agreements that stated if they did not publish their data after six months of completing then they forfeited their authorship to him"(ID: 28). Bullying was mentioned quite a few times, along with coercion, intimidation, and secrecy (publishing someone's work without their knowledge or agreement).

Five respondents noted that gender or sexism served to undervalue the work of women. One respondent observed, "It's very hard to prove sexism, but it is very hard to imagine that I would have been treated this way if I had been a man, based on the experiences of the other (male) students in the lab" (ID:390). Another respondent also mentioned that certain researchers have attempted to avoid or address the issue of gender discrimination: "My advisor always puts herself as last author even though she does a ton of work. I have also had a male colleague drop off a dissertation paper because he thought that people were over-attributing the research to him (my advisor and I are female, and that happens)" (ID:1862).

Many researchers also recounted situations that, while not commonly considered inappropriate, may in fact be ethically problematic. For example, while many perceived bargaining and dealing for professional advancement was not good for science, some did see it as appropriate for career advancement. Another researcher opined that authorship should ethically include all work, including replying to reviewers' comments and adapting authorship to reflect major modifications completed after peer-review: "I would like to bring to the attention of the study authors are the stages that many authors must go through to get a paper published. The survey did not mention anything about replying to the reviewer's comments and the re-writing stages (for example if the first draft and second drafts are written by different people, who should get the credit?)" (ID:2591).

3. External Factors – Rank and Need

In the last two themes – disagreement and unethical practices – respondents commented on various external factors that influenced the decision-making process regarding authorship. Of these, our coders identified two main external factors: *rank* and *need* (Table 2). 178 respondents discussed the notion of need (12.6%) and 413 respondents (29.3%) mentioned rank. The concern about rank was not specific to any one of our rank groupings (i.e., training, early career, pre-tenure, tenure). Women seemed to be somewhat more likely to discuss rank in their comments than men. Similarly, researchers in multidisciplinary teams seemed to be less likely to discuss rank.

The coders opted for a definition of need that was wide enough to include a diversity of needs that people described; however, it has at its core the necessity to survive, advance or be accepted in the system of science. One respondent noted quite plainly that "[i]n my experience across different organizations, the largest factor contributing to the inequitable distribution of authorship is the idea that a particular individual 'needs to be a first author' in order to satisfy requirement for graduation or tenure" (ID:1575). Others mentioned the need to be last author to demonstrate the ability to lead or supervise a project.

In order to compete in academia, respondents acknowledged that researchers need to respect cultural norms, work in large groups, get opportunities, provide opportunities, create networks, promote friendships, and respect unwritten or written rules. A few respondents mentioned the need or requirement for one to be overly inclusive in authorship distribution in order for others to reciprocate and include them as an author, a quid pro quo of sorts. A few also expressed the need to help students publish their thesis and be primary author.

Often respondents thought there was a heightened need for researchers of a certain rank to be recognized. Out of the 178 responses mentioning need, 118 also discussed rank; these two themes are related in various ways. For example, some respondents of higher rank felt a need or responsibility given the prestige of their rank to redistribute recognition by providing more credit to junior scholars whom they deem as undervalued. A senior respondent remarked that, "5 years from retirement, (…) I have to help people build their credentials now, I don't need to build mine anymore" (ID:189). Another respondent commented that, "students need the credits more than I do and *I use it to motivate them to feel responsible, finish and submit the paper* (certainly I have made it to full professor). But I see a big difference amongst colleagues in this area… some claim first authorship on students' work" (ID:277). Indeed, there were supervisors who seemed to think that the need of junior researchers for due recognition was unfounded and they rejected it as a false sense of entitlement: "This concern seems somewhat petty to one who has been around for many years. Perhaps I am too old to understand the generational need for instant and absolute gratification. I grew up in an era that did not give out trophies for participation; one needed to excel to be rewarded" (ID:3762).

Conversely, some respondents thought that there was a need for junior researchers to provide honorary authorship to forge relationships with researchers of higher standing. Some junior scholars did refer to themselves as "newbies" (ID:4135) and mostly "unknowing and inexperienced" (ID:4259) which made them somewhat vulnerable as they may be taken advantage of by other collaborators in the research team. While many reported following their supervisors' mentorship and deemed the experience to be positive and productive, others expressed disappointment. One respondent disclosed that "professors will advise graduate students to include other professors, some of whom may have minimal contributions all for the sake of being 'generous' with authorship. I have not experienced, nor seen the reverse, where these professors reciprocate by extending authorship to graduate students" (ID:3610). In fact, junior scholars described many situations in which they gave authorship to a superior in order to keep their job, fund the lab, and remain in good standing (regardless of contribution towards the work). Contrary to this suggestion, some respondents, who are junior scholars, did affirm that their supervisors had provided adequate opportunity and mentorship.

Some respondents remarked that one's views about authorship distribution and rank evolves with time as one advances in rank in academia: "My experience has largely been that determining authorship is uncontroversial once I reached a more senior level, but for young scientists, where the career is on the line, it can be blood sport. In that sense, I wish you had asked where in the career path a scientist was. My opinion would have been very different if you had asked me 30 years ago." (ID:227)

4. Values

In this study, a value was defined as a standard that is promoted and construed as important. This generally includes notions of ethical or professional thinking about what is "right or wrong". At times, these values are used to justify, enable, promote or ensure ethical authorship decisions. They are also used to discuss the ethics regarding the reward system of

science. These values were used to describe good practices but also to discuss how ethics or values should ideally be used in the system of science. Coders identified three main values: *transparency* was mentioned by 148 respondents (10.5%), *collegiality* was mentioned by 112 respondents (8.0%) and a set of values based in *justice, fairness and equity* were mentioned by 228 (16.2%) of respondents. Within these groups there was no statistically significant difference based on gender, rank, and multidisciplinarity. However, individuals from certain fields – mainly the arts, humanities and social sciences – were more likely to discuss values regarding justice fairness, and equality than individuals in other fields.

Transparency—The notion of transparency was defined by coders as the act of being open, sincere and truthful to avoid fraud, lying and cheating. This includes transparency regarding contribution, authorship and acknowledgements. This code also considers the lack of transparency that was often described as deceit or misrepresentation.

The majority of these respondents discussed the many ways in which the academic authorship system lacked transparency. For example, many suggested that being overinclusive or underinclusive contributed to reducing transparency as to who did and who should be responsible for the work. Respondents considered the naming of many individuals on very large teams to be somewhat dishonest or even outright "intellectual fraud" (ID:203). One researcher suggested that "having 2 prestigious spots (1st and last author) on a paper does not reflect well the relative contribution of the different authors. I have seen the case where 1 author does 99% of the work but the other last/1st author gets as much credit" (ID:1593). A few respondents remarked that the lack of transparency obscured and therefore undermined accountability for research results: "the entire community needs help in understanding where to place and take blame for plagiarism, data manipulation, etc. when there are multiple authors" (ID:145).

Some researchers advocated for transparency within teams through open discussion and collegiality in order to "clarify in writing the details and 'rules' that will be followed in naming and order" (ID:1233). To be transparent about authorship with those outside the research team, some respondents suggested clarifying the types of contribution on the manuscript and/or CV and also determining and submitting the share of all authors in relative percentages. One respondent suggested that publications should emulate the requirement for inventors seeking a patent to document their intellectual property claims (ID:1726). Others highlighted the importance of providing a written agreement to clarify responsibility. Some respondents opined that the lack of overarching or generally accepted guidelines made transparency about authorship open to varying meanings and requirements depending on which of several guidelines were applied, thus allowing for different interpretations. Others remarked that "authorship distribution is a delicate issue, which is not easily amenable to formal guidelines" (ID:8994).

Some respondents did provide a more comprehensive statement, such as the following, to achieve a more transparent system of science:

> All levels of scholars/institutions are responsible for ensuring a fair and transparent system. That means efforts to set standards and even simple training at the level of

institutions, grantors, senior and junior scholars alike, and definitely journals. Journals that publish multi-authored papers should take additional steps to ensure fairness in authorship and order – the editors shouldn't assume this has been dealt with by someone else. With people at all levels concerned with fairness and transparency, the unfair and negative aspects of the system's culture will change more rapidly and everyone will start to learn to have these discussions in productive and positive manners.

(ID:1428)

Researchers also recognized the important limitations of transparency given the difficulty in assessing contribution: "It is difficult to generalize or measure these with specific yardstick" (ID:2046) and "it is not easy to gage the impact of a specific contribution to the manuscript. Most impactful contributions may not be the ones that required the most amount of dedication and work from the co-authors" (ID: 2234).

Collegiality—A recurring message in responses was that disagreements were often linked to a lack of collegiality. This lack of collegiality was blamed on several factors, including the immaturity of young scholars, dysfunctional behaviors, as well as the pressures of competition. However, the notion of collegiality itself was rarely discussed. There were rather vague and all-encompassing statements about how people should generally relate to one another: "In the end the respect of the people you respect is all you can achieve" (ID336) or "I work for fun, with friends. Enough said" (ID:2656).

Those researchers who considered themselves to be in collegial workplaces or teams often mentioned the key elements such as professional behavior, consensus building, mutual respect for people, teams and cultures, amical behavior, inclusivity, harmony, trust, candid conversations and generosity. The comments of this respondent encompass many of these:

> Our group may be an oddball of sorts, but our approach to research team building rests on cooperation, supporting each other, and caring and respecting each other. It may seem not possible in other settings. However, a main mentor (I am the person who established the Institute, a full professor, and throughout the years worked hard to instill this esprit de corps as part of the values of the Institute) needs to continually work things out with incoming researchers and academics. It takes time and effort. Once researchers realize that cooperation is in their interest, they go for it. I think the main issue is not about individuals but rather how institutions are structured, and the processes leading to cooperation versus competition.

(ID:224)

Those individuals who promoted collegiality acknowledged it not only as an inherently 'good value' but also recognized its practical use in making collaboration easier: "The easiest path is to find individuals, who have mutual respect for one another, work collaboratively together, treat one another as you would want to be treated, and park their egos at the door. These qualities should be in place, before soliciting research collaborators." (ID:669) Collegiality had value at the beginning, during and at the end of research

collaborations in motivating team members, facilitating project work and also preventing or mitigating disagreements.

Some respondents suggested that collegiality – or more precisely collective interaction – throughout a research project was a win-win for all parties involved in research: "Intellectual activities are always collective. Except cases that there is a specific data collection, most of the arguments and/or proposals are hard to be individually owned. In a collective work, there are also moments of strategic intervention that increases researchers' motivation. Hence, social collaboration can hardly be translated into calculated results fairly." (ID:2429) This last comment suggests that the social dynamic inherent in collaboration generates a synergistic force that makes calculating individual contribution all the more complicated and perhaps even counterproductive. Yet, as one researcher explained, even in a very collegial team, there can be issues with authorship (albeit less frequently): "Most of the time, most academics can work out both who should be or not on a paper in a collegial fashion and on the order of authorship. However, when there is a problem with either of these it becomes a major issue and can generate a lot of bad blood. So, the experience is infrequent but intense, in my experience." (ID:2851)

Justice, fairness, or equality—A total of 228 (16.8%) respondents mentioned some notion of justice, fairness or equality. We grouped these justice-related terms because they are sometimes used interchangeably by respondents as having the same or similar meaning. Moreover, it should be noted that some researchers simply used the word "fair" as a substitute for ethical. In other words, "the fair distribution" relates to "ethical distribution" and not to a specific notion of justice. Regardless of the fact that the meaning of "fair authorship" was rarely clearly defined, many respondents considered it to be important: "The fair distribution of authorship is crucial for creating and fostering healthy research environment at institutions and promoting a sense of participation among researchers and encouraging further research" (ID:481). Another researcher responded that "the fair distribution of authorship is the most solid basement for the further smooth collaboration with a research team. It has a timeless value." (ID:3641). But other respondents remained somewhat skeptical as to any practical application of fairness: "Guidelines and open discussion about this is needed yet I'm skeptical about this due to the inegalitarian character of most academic environments" (ID:296). One researcher simply stated,"life is not fair, but it would be better if it were" (ID:1097).

Some advocated for complete equality: "all authors are equal and should be treated as such" (ID:391). It was noted that procedures should be fair and discussion should take place throughout the research. Others suggested that we should evaluate the importance of every collaborators' contribution and give fair recognition based on the level of contribution. Many respondents pointed to situations that they thought were unfair and often unethical, as was previously noted; this included cases of honorary authorship, overinclusion, and exclusion. Some considered it unfair that certain types of contributions could be undervalued, such as technical analysis, model creation, statistical analysis, and so forth.

A number of respondents raised concerns about their perceived unfairness of authorship order: "It is common practice to write authors in alphabetical order. It is unfair that only the

first author is cited or first author et al is written especially when other authors had made a major contribution. Reverse alphabetical order should also be considered" (ID:3572). One individual who worked in multiple fields including social sciences, humanities, engineering, neuroscience and performing arts admitted using many different orders to ensure a level of fairness. However, this respondent added that it would be helpful "to recognize a group of contributors as main authors and a group of collaborating (contributing to various degrees to the outcome of the research), without referring to order that is usually implicitly evaluated in decreasing order" (ID:2671).

Many researchers recognized a level of complexity in applying fairness and noted that many elements had to be considered: "Distribution of authorship in a team is just like any other interrelation in an academic institution and life itself; you have to account on friendship, leadership, seniority, academic respect, promotion of new research with potential, family links, etc. You might run across any of these cases but most of the time academics collectively balance the fairness of authorship distribution" (ID:1320). Other respondents pointed to a degree of subjectivity in the determination of fairness and unfairness and remarked that in various contexts within the system of science, "It all depends on the team you work with" (ID:125). A rather significant number of researchers commented on the extent to which distribution differed according to discipline:

> I think it varies by discipline – in the sciences it seems the last author is the most senior scholar, but in other social sciences it is more valuable to be the first author. (…) I think you just have to have a discussion for each manuscript before the writing process begins to make sure that everyone is in agreement over authorship, and that everyone who would benefit from authorship and who contributed is recognized fairly.
>
> (ID:90)

Although some would suggest that it is "fair" to follow one's disciplinary norms, some argued that these were counterproductive and worked against fairness: "My field frowns upon multiple authors (beyond roughly three). This makes it difficult in conversations on authorship as the team WANTS to be fair but discipline can serve to limit this ability" (ID:2771).

A number of respondents found funding metrics to be unfair because of the comparison of outputs from different fields that publish at different rates: "I see significant differences in the culture of authorship among knowledge areas. Some of my colleagues who do experimental research in labs are 'used' to publish articles with 5 to 15 co-authors. In my field, we rarely publish an article with more than 3 authors. Situations like this create unfair competition for grants and other academic achievements" (ID:678).

Some respondents advocated for redistributive justice so that credit could be given to those who need it most: "The fair distribution also does depend on the seniority of those involved because being a professor already I want to help promote younger staff so tend to let their names go before mine even if I have done most of the work!" (ID:13). Another researcher suggested that fair distribution in the context of collaborations needed to also acknowledge the pressures of team members working together to achieve outcomes:

I find that being 'fair' often means acknowledging those constraints and working together to make sure all members on a team have the opportunity to be a single author or be a first author when needed. For example, I have not been an author on papers that I contributed equally on from project conception to publication because a colleague needed single authored publication for promotion and tenure. In this sense, fairness is not about the contribution to the work but is always situated in larger conversation about how to work within and again [st] neoliberalism in the academy.

(ID:7000)

Discussion

This study suggests that authorship distribution is is not only a theoretical issue about what should be fair, but its becoming an issue that affects a person's worth and relationship to their colleagues. Although some researchers may talk in rational terms about ways to better compare contributions, none relish the hostility, sadness, and frustration of disagreement. The values of rigor and objectivity that often guide researchers in completing their research projects are ill suited for distributing something as subjective as authorship. This subjectivity is found in the inability to compare contribution but also in the values that surround authorship such as fairness.

As previously noted, some researchers mentioned their preference for working with like-minded individuals who think in the same way about contribution in order to avoid problems. This is somewhat counterproductive given the push towards multidisciplinary and international research that seeks to promote a greater diversity of perspectives, skills and experiences in science. The findings of our quantitative research indicate that members of multidisciplinary teams do not experience a greater incidence of disagreement, rather, they experience fewer disagreements (Smith et al. 2019); Bennett and colleagues suggest that the strength in multidisciplinary science is to "promote disagreement while containing conflict" (Bennett and Gadlin 2012). More specifically, the idea is to create a safe environment or open forum where controversial topics may be addressed, scientific disagreement explored and constructive, productive interaction may lead to novelty. Some studies suggest that very important or innovative studies come from radically different disciplines (Larivière et al. 2015); however, it could also be argued that the newest and most creative inventions in science may come from outside the mainstream of research. In the scientific process of hypothesis testing, and trial and error, it may also be the case that a unexpected scientific idea may prove invalid, but nonetheless open up new horizons to further discoveries.

Where scientific disagreements may exist within a team, it is critically important that they not become personal conflicts (Bennett and Gadlin 2012). This can be especially difficult to achieve regarding authorship. Ideally, one should objectively and dispassionately evaluate contributions; however, the personal and professional ramifications on the researcher seeking recognition, credit, career opportunities, and funding cannot be ignored. It is not simply about methodological design or choice of a suitable scientific framework.

A few respondents in this study emphasized the temptation to work only with "like-minded thinkers" to avoid conflict, disagreement and hurt feelings. Many researchers were mentored to do good science, but not necessarily be good communicators. The power-dynamic makes communication by and between junior scholars and senior scholars particularly difficult. One must wonder if the incapacity to communicate with non "like-minded" thinkers also has an effect on team diversity and scientific debate. Hypothetically, this in turn may lead to "group think" that takes place when collective decision-making becomes a vote of popular opinion (usually that of the status quo) – thus neglecting unpopular or dissenting opinions (Packer 2009). Although one may argue that like-minded researchers can have healthy disagreements about science but not about authorship, this could become a difficult balance to keep.

Our respondents described authorship as a "need", a survival tool of sorts. With this in mind, some justified various types of questionable behaviors. According to much of the literature, especially in RCR, honorary authorship is often seen as the main issue in authorship ethics (Elliott et al. 2017; Greenland and Fontanarosa 2012). Recently, Ioannidis, Klavans and Boyack (2018) have shown that thousands of scientists publish a paper every five days; and that the number of hyperprolific authors grew more than twenty fold from 2001-2014. In this last study, the researchers suggested that the increasing number of hyperprolific authors does not necessarily prove questionable behavior, as in many cases, these were from fields where authorship practices are quite peculiar, such as high-energy physics.

Although Ioannidis and colleagues did not set out to prove any wrongdoing, researchers who are apparently able to publish every five days should raise numerous and serious ethical questions about how this level of productivity is achieved and what it means for individual researchers. Many researchers who answered the qualitative questions in our study were very much against large teams and highly prolific authorship. However, while ethicists have suggested that hyperauthorship's main problem is not knowing who is responsible for the research and who is accountable for any wrongdoing, respondents found deceit to be most problematic. The simple fact that people may be lying about authorship may make them less trustworthy, fraudulent, and corrupt individuals. This sense of deceit and lack of sincerity was also mentioned during the interpretation of authorship guidelines. The fact that many respondents mentioned that individuals emulate ethicality by falsely interpreting guidelines without valuing notions of fairness and justice highlights a serious problem. Given the diversity of research contexts, it would be unfeasible – and most likely unwise – to have guidelines that include all contextual specificities. As such, following guidelines will never be the "be all, end all" of authorship ethics. As suggested by Hren and colleagues (Hren et al. 2013), authorship distribution cannot be limited to rule applications because authorship includes moral decision-making that involves a complex mix of interpretation of principles and rules as well as intuitive processes.

One important part of that intuitive process is the influence of rank and power. It is not surprising that many individuals in our study considered rank to be an important influence on authorship. Two different notions seem to co-exist. First, there is the notion of *power* – the longer one has been in research, the more prestige and name recognition one will have. In this situation, researchers will have acquired scholarly privilege that gives way to what

Merton identified as the "Matthew effect", whereby those with the most publications further increase their chance of future publication (Merton 1968). The related quantitative study resulting from the same survey data suggests that gender is also significantly likely to effect rates of disagreements amongst participants (Ghiasi et al. 2015; Rossiter 1993). In other words, researchers that are women self-declare being in disagreements much more often than men, but disagreements are perceived to be a question of power based on rank and seniority.

However, in discussions about rank, the notion of supervision and mentorship was also considered important. According to a recent survey by Patience and colleagues (2019) amongst close to 6,000 of science's top cited researchers, one thousand individuals thought that supervision should always be included while the same number of researchers thought it should never be included. Qualitative results in our study suggest that supervisors often have the power to redistribute recognition through authorship. In other words, the powerful can determine who will be the next generation of prominent authors. Although some did mention that they were trying to "help" groups that may have been undervalued in the past, most mentioned that they wanted to help their own students.

Although mentoring offers all types of benefits to junior scholars, such as learning how to do research, networking, accessing resources, gaining access to an inner circle of researchers, etc., (Sambunjak et al. 2010) one may wonder if mentorship unfairly determines authorship positions. For example, if individual X contributed the most to the research but will not continue working in research while individual Y, who has done minimal work, is actively seeking professorship employment and funding, a mentor may conclude that Y has a greater need for authorship for their career. Some may consider naming X as the first author to be accurate based on contribution but a waste of important symbolic capital. There is no doubt that giving credit based on contribution may be considered fairer, but mentors may feel pushed to place capital (i.e., authorship position) where they consider the investment to be most profitable in the long run.

Similarly, mentors have the capacity to give more opportunities – from the onset of the research – to contribute to those they deem to be more successful. That being said, the mentor also has significant power to open doors and provide opportunities to the next generation of researchers. Although this type of redistributive justice may be well intentioned, it may also further complicate matters by permitting redistribution fueled by personal and professional opinion and feelings about who deserves "a leg up". Imagine the realistic yet hypothetical context were mentors feel compelled to distribute authorship by prioritizing students that they consider to have a future in academia. In so doing, the Matthew Effect would become intergenerational. In other words, those with publications and power would have a significant input into who will succeed. In this way, researchers may decide to pass on an inheritance to those they deem worthy.

One main issue about redistributive justice is its inability often to be transparent. Giving someone credit for something they did not do cannot be justified in a transparent way. Although some respondents in our study thought that the main issue plaguing the authorship system was transparency, many suggested that simply knowing who did what does not *de*

facto ensure or equate with fairness. It was no surprise that respondents discussed some type of notion of justice or fairness since it was also included in the survey questionnaire. Although there was a lot of vagueness about what was fairness, many respondents noted that such authorship decisions were subject to a complex array of institutional, systemic and group influences that affect individuals on a personal level. Although many noted that they try not to stay frustrated or remorseful after the paper is published, the number of lengthy stories of grievances shows a certain bitterness for experiences deemed "unfair". There was significant cynicism amongst respondents that scientific talent and contribution may be less important than networking in gaining prominence.

Limitations

Given the qualitative nature of our study and the type of questions that we asked, the results are *not generalizable*. Further, certain themes were particularly difficult to identify and define in a way that could be coded by independent coders. The notion of transparency seemed problematic because we wished to include not only transparency regarding contributions but also transparent behavior, which can be interpreted in various ways. The quantitative data regarding gender, rank, discipline and multidisciplinarity in this paper is only descriptive and so not meant as a predictor of future behavior. Since the survey asked questions about ethics, it is important to mention that there is generally underreporting with any type of behavior that is viewed as undesirable.

Conclusion

Our qualitative study confirms and builds upon previous research on authorship and adds to our understanding regarding the complexity of authorship distribution. For example, honorary authorship is quite commonly identified as an unethical behavior throughout the scholarly literature (Al-Herz et al. 2014; Elliott et al. 2017; Flanagin et al. 1998; Greenland and Fontanarosa 2012); it is problematic since one cannot be held accountable for work one has not conducted. However, this is an overly restrictive view of authorship ethics. According to our study, what troubles researchers is not misattribution of responsibility related to honorary practices but rather the tacit acceptance of deceit in a broader sense. Deceit is found in honorary authorship but also in problematic and ill-intentioned use of guidelines, as well as a general lack of transparency that creates a context of secrecy. Respondents in our study seem to think that many of these problematic behaviors regarding authorship may transfer into the broader science practices and thus have an effect on scientific projects. In other words, if a researcher deceives colleagues or the public regarding authorship, they may have equally problematic practices in their research. Rather than a momentary lapse in judgment, a little lie about authorship may be perceived as a generalized lack of integrity.

Although our study sought to understand respondents' views of "fairness" in authorship distribution, something that is indeed considered central to good practice, few respondents explained explicitly what "fairness" actually entails. Although most suggested that disagreements should be reduced through collegiality and open discussion, these seemingly simple concepts are increasingly difficult to operationalize in the context of competition and

in situations where power discrepancies may have significant influence on decision-making. Ethicality and fairness regarding authorship seem to run counter to the perceived "need" to survive in academia, which entails publication, networking and opportunities. Not only do researchers have a tendency to disagree about authorship, they also have a diversity of views of what ethical authorship decision-making is and should be. Authorship guidelines will always have their limitations, it is how teams interpret and operationalize the surrounding values – such as collegiality, fairness, and transparency - that will reduce hostile and counterproductive authorship disagreements.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Characteristics of participants responding to qualitative query when compared to total survey respondents

	Sample responding to qualitative query	% of qualitative sample	Sample responding to broader survey	% of sample that answered survey
Field				
Arts and Humanities	48	3.4%	251	19.1%
Medical Sciences	432	30.7%	2482	17.4%
Natural Sciences and Engineering	641	45.5%	4130	15.5%
Social Sciences	277	19.6%	1467	18.9%
Missing	10	0.7%	34	29.4%
Gender				
Female	495	35.1%	2090	23.7%
Male	879	62.2%	3694	23.8%
Other	1	<<0.1%	6	16.7%
I prefer not to answer	20	1.4%	61	32.8%
Missing	13	0.9%	2523	0.5%
Rank				
Training	97	6.9%	644	15.1%
Early Career	255	18.1%	1511	16.9%
Mid-Career	440	31.2%	1703	25.8%
Tenure or senior	392	27.8%	1327	29.5%
Other	217	15.4%	681	31.9%
Missing	7	0.5%	2498	0.3%

Table 2:

Description and Frequency of Thematic Codes Pertaining to Ethics

Title	Description	Count
Disagreements		
Disagreement between people or groups	Explicit disagreements between individuals or groups • Includes a range of differences of opinion which lead to animosity, hostility, disputes, tension, conflict or frustration • Excludes disagreements between ideal practices that are categorized as unethical or questionable practices	156
Unethical practices or questionable behavior		
Unethical practices or questionable practices	Explicit observation of wrongdoing or perceived wrongdoing. • May also include what participants consider to be particularly problematic practices	308
External influences regarding authorship		
Need	Require (something) because it is essential or very important. Expressing necessity or obligation for career advancement	178
Rank	Rank or role includes the role given to individuals which is linked to rank to social hierarchy of science. • May include power discrepancies	413
Values regarding authorship		
Transparency	The act of being open, sincere and truthful to avoid fraud, lying and cheating • Includes transparency regarding contribution, authorship and acknowledgements; and lack of transparency which is often described as deceit or misrepresentation • Excludes regulations or practices that indirectly result in transparency	148
Collegiality	Promoting the value of cooperative relationship between individuals. • May include notions of mutual respect	112
Justice, fairness, or equality	Any comment that refers to values of justice, equality or fairness	228
Other		
Comment regarding survey	Any suggestion, comment, critique about the survey instrument or the research project	96
No other comments	Explicitly stating no, N/A, or something intelligible	205

Table 3:

Summary of logistic regression results

Row	Codes	Rank			Gender			Multidisciplinarity			Field		
		Chi	DF	P	Chi	DF	P	Chi	DF	P	Chi	DF	P
1	Disagreements	2.01	4	0.73	0.25	1	0.61	4.93	4	0.29	4.10	3	0.25
2	Unethical practices	9.39	4	0.05	7.26	1	<0.01	17.37	4	<0.01	2.74	3	0.43
3.1	Need	2.97	4	0.56	0.87	1	0.35	16.88	4	<0.01	12.84	3	<0.01
3.2	Rank	11.34	4	0.02	14.64	1	<0.01	10.45	4	0.03	5.55	3	0.14
4.1	Transparency	0.96	4	0.91	1.29	1	0.26	4.84	4	0.30	6.95	3	0.07
4.2	Collegiality	7.33	4	0.20	1.46	1	0.25	4.35	4	0.36	3.98	3	0.26
4.3	Justice fairness or equality	5.11	4	0.28	1.07	1	0.30	2.97	4	0.56	8.13	3	0.04