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Addressing authorship dilemmas in scholarly publications: a solution-oriented study

Rahul Aggarwal

Environmental Systems Analysis, Chalmers University of Technology, Gothenburg, Sweden

ABSTRACT

In scholarly publications, determining authorship- and the order of authors' names- has become increasingly challenging. This is partly due to the evolving landscape of multidisciplinary teams, which can involve numerous contributors. Relying solely on descriptive and consensus-based qualitative approaches can lead to uncertainty. The dilemma also extends to cases where a valid contributor may simply receive an acknowledgement for his or her contribution, rather than being listed as a joint author. Trusting authors to adhere to moral standards when deciding authorship and acknowledgments can result in conflicts that are difficult for readers to navigate. This poses accountability challenges, especially when dealing with a substantial number of authors. This study proposes a simplified and transparent quantitative approach to address these concerns. The methodology is based on two key parameters: first, the evaluation of the time invested by each contributor in the publication; and, second, the normalized assessment of the value of their time. Through a contribution analysis utilizing these parameters, a predetermined threshold is established to define authorship. Contributors falling below this threshold can be recognized in some other way, for example, in acknowledgments for their valuable input. While the approach proposed may be more applicable in some disciplines and higher education systems than others, it does offer a quantitative foundation to support qualitative discussions among potential authors, helping them reach a consensus on authorship and authorship order without conflict. This method seeks to prevent injustices and ensure that all contributors have a voice, regardless of their power and influence.

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1. Introduction

The pursuit of knowledge is widely recognized as a key driver of both societal advancement, and catalyst for economic development (Bruce 2003). In the academic sphere, broadly speaking this knowledge mechanism consists of three essential components. First the knowledge creators- including academicians, researchers, and scientists, who generate new material as the basis for knowledge development. The second component involves the dissemination of scientific information and research findings globally to society (Dolmans et al. 2022; Siegel et al. 2004). The third component includes the recipients of this information, who use it to either further advance their understanding or to develop practical applications (Bornmann and Marx 2014). The crucial link between the

CONTACT Rahul Aggarwal rahula@chalmers.se Environmental Systems Analysis, Chalmers University of Technology, Vera Sandbergs Allé 8, Gothenburg 41296, Sweden

generation of information and its utilization for societal progress is its dissemination, which primarily occurs through scientific publications (Dearing, Kee, and Peng 2012; Foray 1997). To help assess the validity of the evidence presented, academic dissemination processes incorporate an independent peer review process that, ideally, is intended to root out unverified material (Boudreau, Gefen, and Straub 2001; Jasanoff 2011). These processes are typically facilitated by scientific or peer-reviewed journals (Dimitroulis 2011).

Within this flow of information through journals, two elements are critical: understanding what the information entails and identifying those who generated it. The classification of information depends on the type and focus of journals (Waltman and van Eck 2012). Different journals cater to specific topics, allowing individuals to follow particular journals to access the information they are interested in. Another crucial aspect is establishing accountability and recognizing contributors for their efforts (Rennie, Yank, and Emanuel 1997). However, it is becoming increasingly challenging to ascertain the integrity of scientific communication, particularly in identifying those who generated the information (Ali and Djalilian 2022; Gasparyan, Ayvazyan, and Kitas 2013; Justin et al. 2022; Khalifa 2022; Khezr and Mohan 2022; Pruschak and Hopp 2022; Teixeira da Silva and Dobránszki 2016b). Authorship-related decisions remain one of the most problematic issues, sometimes even shaking the foundations of research.

Determining who generated the information has become more challenging in the present and is likely to become even more complex in the future. In the past, identifying information generators was relatively straightforward, as sole authorship dominated scholarly publications until the twentieth century, typically involving only a few researchers (Greene 2007). In contrast, today's research landscape emphasizes research productivity, requiring researchers to be both prolific and maintain high-quality output (Carpenter, Cone, and Sarli 2014; Patel et al. 2011). This drive for productivity has led to the outsourcing of various research components, involving different experts and fostering transnational cooperation (Zuo and Zhao 2018). Consequently, publications often have multiple authors from diverse fields, research institutions, departments, and even different parts of the world (Clarke 1964; Lissoni and Montobbio 2015; Teixeira da Silva and Dobránszki 2016a; Yousefi et al. 2012). The 'Publish or Perish' mantra has significantly influenced current authorship patterns, increasing the number of authors per publication, sometimes without clear justification for authorship, thereby creating a gray area of ambiguity (Grech 2022; Guraya et al. 2016; Osunsan et al. 2022). This mantra is based on the pressure researchers face to publish to enhance their curriculum vitae for promotion, build academic and professional reputations, and gain credibility when applying for grants and funding (Angell 1986; Johann 2022; Kearney, Downing, and Gignac 2024; Mertkan, Onurkan Aliusta, and Bayrakli 2022; Wang et al. 2024).

Authorship-related decisions present several critical challenges (Dreyfuss 2000; Macfarlane 2017). First, it is essential to determine who qualifies as a contributor to a scientific publication. Second, there is the challenge of how to appropriately recognize and reward contributors, either by listing them as authors or acknowledging their contributions in the acknowledgments. Third, deciding the order of authors poses another challenge. From a reader's perspective, identifying the main contributor or conducting a contribution analysis among different authors becomes increasingly important as research becomes more multidimensional and diverse (Yank and Rennie 1999). In this context, some aspects of the research may be deemed more significant than others, and making these determinations often relies on subjective consensus among the authors.

In recent decades, global discussions have increasingly revolved around achieving consensus across all research domains regarding authorship criteria in scientific publications. This endeavor is reflected in the published literature and guidelines from various publication editors, encompassing editorial policy statements and authorship criteria (Bates et al. 2004; Gasparyan, Ayvazyan, and Kitas 2013; Resnik et al. 2016). For example, Gasparyan, Ayvazyan, and Kitas (2013) provide a comprehensive list of editorial policies and criteria for determining authorship. However, the decision on who should be considered an author is often left to the authors themselves. In the absence of standardized guidelines, this determination has become progressively challenging, as all contributors

tend to view their input as essential and aspire to authorship. Additionally, there is a recognized conflict of interest, as individual research performance, often measured by widely applicable metrics like the h-index, that is enhanced by being listed as a co-author rather than an acknowledged contributor (Bornmann and Daniel 2009). For example, Slone (1996) concluded that undeserved authorship is a common and serious problem, primarily driven by academic promotion policies. The more co-authorships one has, the greater the recognition and opportunities for collaboration in multidisciplinary research (Juyal et al. 2014).

While there is a global consensus on the significance of establishing clear authorship criteria, the challenge lies in creating effective measures. Despite substantial efforts by editorial policies, the development of universally applicable and straightforward authorship criteria remains a work in progress. Existing methods often rely on extensive qualitative judgment and consensus, which can sometimes appear tilted in favor of authors who hold power and influence over decision-making, rather than being objective (Gasparyan, Ayvazyan, and Kitas 2013). Authorship decisions could benefit from a comprehensive set of quantitative criteria that can be distilled into a representative and user-friendly decision-making process. Such quantification would support informed authorship decisions by allowing authors to assess their contributions objectively, while also facilitating qualitative discussions to build consensus and reduce conflicts.

This study proposes a straightforward and transparent quantitative approach based on two parameters: first, the evaluation of the time invested by each potential author in the publication, and second, the normalized assessment of the value of their time. The objective is to develop an approach that is both acceptable and easily applicable to any publication, minimizing the need for extensive subjective judgment. By utilizing readily available data, this method simplifies the determination of authorship. The objectives are: first, to define the scope of contributors to scientific publications; second, to create a quantitative approach to determine who qualifies as an author or should be acknowledged as a contributor; and third, to establish a method for determining the order of authors. The aim is not to replace qualitative discussions among potential authors regarding authorship but to provide a quantitative foundation that supports these discussions. This approach helps potential authors reach a consensus on authorship and authorship order without conflict, preventing injustices and ensuring that all contributors have a voice, regardless of their power and influence.

2. Methods

The methodology of the study is structured as follows: Section 2.1 discusses the criteria for qualifying as a contributor to a scientific publication. Section 2.2 outlines the selected parameters for the quantitative approach, and Section 2.3 details the construction of the quantitative approach for authorship.

2.1. Qualifying as a contributor to a scientific publication

The first step in any scientific publication is to identify all contributors, irrespective of their roles. In this study, all individuals involved are considered as contributors. Once someone qualifies as a contributor, they must be acknowledged. The next step is to determine the authors among all contributors. Authors are those who have made substantial contributions to the publication (Slone 1996). According to the Council of Science Editors' policy paper on integrity in scholarly journals, providing writing assistance, research advice, financial support, or technical and administrative help alone does not justify authorship (Editorial Policy Committee 2023). However, this study suggests that if individuals contributed to the publication, they should be considered potential authors.

Furthermore, this study emphasizes that all potential authors must meet a crucial criterion: they must provide final approval for the version submitted for publication and be prepared to take full accountability for its content as a whole rather than in parts. Simply contributing

to a publication without a comprehensive understanding of it and the ability to defend it is insufficient for authorship. If a potential author contributed but cannot take accountability for the entire publication or defend it adequately in response to readers' concerns, then that individual cannot be considered an author (Rennie, Yank, and Emanuel 1997). Being an author means not only contributing to the publication but also understanding how one's contribution fits into the overall publication and affects the results and conclusions that readers will interpret. If someone provides data or performs analysis without understanding the publication well enough to assess their contribution in the context of the entire work, they are merely a contributor and not an author. Intellectual contribution requires a broader understanding and the ability to explain and justify the work as a whole. Many publications have been retracted because the listed authors did not take ownership of aspects that later proved to be false, such as statistical analysis or illustrations (Xu and Hu 2018). The number of articles retracted annually has increased in recent years. While some retractions are due to unintentional errors (Fanelli 2016; Nath, Marcus, and Druss 2006; Teixeira da Silva 2022; Teixeira da Silva and Al-Khatib 2021), many are a result of misconduct (Cokol, Ozbay, and Rodriguez-Esteban 2008; Steen 2011; Wang et al. 2023; Xu and Hu 2022).

This study recognizes that among multiple authors, the level of understanding of each part of the work can vary, with authors often being experts in limited aspects of the study rather than all aspects. The aim of multi-author studies is to leverage diverse expertise, which enhances the quality and depth of the study. Therefore, in addition to making substantial contributions to the publication, and taking accountability for the entire publication, authors should also clearly define their individual contributions and be accountable for the accuracy and integrity of the sections within their area of expertise. This can be documented through contributorship statements (Marušić et al. 2004). Clarifying accountability and responsibility among multiple authors for specific parts of the study helps readers understand each author's contributions. The criteria for authorship set by the International Committee of Medical Journal Editors (ICMJE) and the 14 roles outlined in the Contributor Roles Taxonomy (CRediT) provide structured ways to disclose contributions by listing each author's specific roles at the end of the paper (Cobey et al. 2021; Holcombe 2019; Larivière, Pontille, and Sugimoto 2021; Mondal, Mondal, and Haldar 2023).

Defining authorship addresses many concerns regarding inappropriate authorship practices. First, it addresses 'Honorary authorship,' which occurs when authorship is granted to honor individuals who provide resources like facilities, academic support, or technical assistance but do not contribute to the writing or primary data collection (Meursinge Reynders et al. 2022; Moffatt 2011; O'Brien et al. 2009; Waleed et al. 2014). These individuals act more as facilitators than as contributors. Second, it addresses 'gift authorship,' which involves adding someone as an author without contributing (Gülen et al. 2020; Jones and McCullough 2015; Manton and English 2008; Smith 1994). Some researchers use the terms honorary, guest, and gift authorship interchangeably. While these types of authorship may enhance the recipient's research profile or benefit the study's authors, these are considered unethical for both parties involved. Feeser and Simon (2008) classify gift/honorary authorship into two types based on who initiated it and whether it was voluntary or not. The first type is when genuine authors voluntarily initiate it for reasons such as increasing the chances of the paper being accepted for publication (known as –'courtesy authorship') (Bennett and Taylor 2003), enhancing the paper's acceptability among readers, or pleasing someone for potential favors or collaborations (Olesen, Amin, and Mahadi 2018). It can also be a gesture of gratitude to influential individuals or those who provided access to facilities or funding, or a means to help young researchers advance their careers (Bennett and Taylor 2003; Claxton 2005; Yukawa, Kitanaka, and Yokoyama 2014). The second type is involuntary, where authorship is forced, a practice known as 'coercion authorship' (Strange 2008). This occurs when non-contributing individuals, such as senior members or head of a laboratory or department, directly demand inclusion as authors. It can also occur indirectly, influenced by norms or traditions within the working environment (Claxton 2005; Gureev, Lakizo, and Mazov 2019).

Third, it addresses 'ghost authorship,' where a contributor's name is omitted from authorship or acknowledgment. From the author's perspective, this practice denies their contribution, and from the reader's perspective, it conceals who contributed, preventing acknowledgment or accountability in case of disputes (Gülen et al. 2020; Mowatt et al. 2002; Ngai et al. 2005; Ross et al. 2008; Wislar et al. 2011). Ghost authorship can manifest in two ways. First, an author may intentionally want to be excluded. This sometimes can occur in industry-sponsored articles where corporate employees conduct the research but are not listed as authors to make the research appear objective, even though it may still be biased in favor of the industry (Okike et al. 2008). This can also happen when authors do not want to take accountability or when the research is not supported by funding organizations (Olesen, Amin, and Mahadi 2018). Second, authors may want to be co-authors but are excluded due to a lack of awareness of authorship criteria, which often affects young researchers and students. Alternatively, they may be intentionally excluded by other authors who have the power and influence to deny authorship for their own benefit (Shaw and Elger 2017). In cases of ghost authorship, peer reviewers who are actively involved during the submission and contribute to the publication should be acknowledged (Gasparyan et al. 2011). The responsibility of including peer reviewers lies with the research publication journal to create a dedicated section in the acknowledgments to list the names of peer reviewers and editors who review the publication, ensuring their contributions are recognized and allowing for accountability in case of disputes.

This study proposes that 'honorary authorship' may qualify for acknowledgment but not for authorship, 'gift authorship' does not qualify for either acknowledgment or authorship, and 'ghost authorship' should be addressed by ensuring all contributors are acknowledged or listed as authors if they meet the criteria. Failing to uphold the ethical obligation to recognize all contributors, including those who decline authorship or do not wish to be authors, constitutes misconduct not only within the research community but also towards with the readers, who have the right to know who contributed to a research publication (Bennett and Taylor 2003).

The order in which authors are listed can reflects their level of contribution, research responsibilities, and involvement in writing and coordinating the publication, as well as their seniority in some fields (Baerlocher et al. 2007; Costas and Bordons 2011). However, universally accepted rules for determining author order are lacking (Whetstone and Moulaison-Sandy 2020), and the extent of contribution often serves as the primary determinant across scientific disciplines (Lake 2010). In most research publications, the first and last positions hold special significance (Helgesson and Eriksson 2019). The first author typically has made the most significant contribution to the research and writing, while the last author, often a senior scientist, principal investigator, or research professor, usually provides guidance and suggestions, making a lesser direct contribution. There has also been a trend of assigning equal credit to the first and second authors of original papers when appropriate (Huang, Hsieh, and Lin 2016; Khoshpouri et al. 2019; Lapidow and Scudder 2019; Teixeira da Silva 2021; Wang et al. 2012). Nevertheless, there is still no specific guidance on precisely measuring equal contribution (Teixeira da Silva 2021).

Sometimes, the order of authorship is determined before the study begins among potential contributors and is then revised as needed (Washington University in St Louis 2009). Tscharntke et al. (2007) describe four different models for determining authorship order: the 'sequence-determines-credit' (SDC) model, where authors are listed in order of decreasing contribution; the 'equal contribution' (EC) model, where authors are listed alphabetically; the 'first-last-author-emphasis' (FLAE) model, which highlights the contributions of the first and last authors; and the 'percent-contribution-indicated' (PCI) model, where the percentage of each author's contribution is specified. There are also discipline-specific differences in how authors are listed. For example, in mathematics, and, to some extent, in theoretical computer science, social sciences, humanities, political science, and other related disciplines, authors are often listed alphabetically regardless of their contribution, following the Hardy–Littlewood Rule, which emphasizes the 'equal contribution' model (Avula and Avula 2015; da Silva and Dobránszki 2013; Levitt and Thelwall 2013; Liu and Fang 2014; Teixeira da

Silva and Dobránszki 2016b). In biosciences, the last author is typically the senior researcher or professor who conceived the idea, secured funding, owned the research space, and supervised the other authors. In contrast, in public health, the last author is often the one who did the least amount of work.

In some research teams, authorship order is also determined by fairness, to ensure that everyone gets a chance to be the first author, or by consensus based on who would benefit most, such as someone applying for tenure positions or young researchers (Macfarlane 2017). In many cases, the last author is the most senior member, the one whose grant funded the research, or the lab owner (Marco 2004). However, it is not always clear whether they contributed more or less than others. These practical discussions for determining authorship order often rely on consensus, discussion, and sometimes the decisions of dominant authors or traditional norms within the working environment. While these methods can be practical, they leave gaps that can be exploited by those with more power or influence. Quantification of the contributions provides a logical framework to ensure fairness and equity, particularly for those who lack power or influence in the decision-making process (Clement 2014; Verhagen et al. 2003). This approach helps prevent unjust outcomes and ensures that contributions are fairly recognized.

2.2. Authorship quantification approach and its parameters

The quantification of authorship is a comprehensive approach designed to assess authorship for a publication, utilizing a range of indicators to capture various aspects of authorship (Clement 2014; Whetstone and Moulaison-Sandy 2020). This study aims to develop an approach that is both broadly applicable and quantifiable for any publication using readily available data. Therefore, the approach is designed to be applicable across all publications, regardless of their subject matter and type.

The primary parameter selected for this approach is the time invested by each contributor in the publication before its submission to a journal, excluding the contribution of reviewers, which falls under the scope of the journals. Time investment data is typically recorded by individuals for time management purposes and is consistently available with a reasonable accuracy. This data can be further divided into categories such as office time, voluntary time, personal time, and other classifications for more detailed analysis. Another critical parameter is salary data or hourly rates of each contributor, which are used to assess the value of their time. Both organizations and individuals maintain records of salaries for financial management purposes, and this data can be harmonized to calculate the value of each contributor's time. While additional factors such as educational level, geographical location, type of institution, contributor rankings, expertise levels, contribution significance, and roles in the publication could enrich the quantification process, these factors are often personal, subjective, or perception-based, making them not universally accepted. Furthermore, what is considered a norm in one discipline may not be relevant in another due to discipline-specific biases and criteria for determining authorship (Johann and Mayer 2019; Whetstone and Moulaison-Sandy 2020). By limiting the scope to these two parameters, this study aims to provide a simplified, transparent approach that can be easily adopted for determining authorship.

The parameters selected in this study for the quantification approach may have certain limitations, which are discussed below:

- **Inaccurate Time Reporting**: Contributors who qualify as potential authors might believe they spent more time on the publication than they actually did, exaggerate their time investment, or even falsify their time records. Additionally, many researchers are not skilled in time reporting, do not keep records, and those who claim they do so often create these records retrospectively. However, these limitations largely hinge on trust, as contributors are expected to reasonably estimate the time they spent on the publication, given their other work commitments. This study assumes that in academia, personal integrity will motivate researchers to provide honest estimate

of their time without the need to document every minute. Furthermore, if a researcher is involved in tasks that contribute to multiple publications, time should be appropriately allocated among the different projects. This practice is supported by European projects, where researchers typically work on multiple work packages and must report their time for each one on a monthly basis. In recent years, many projects have required researchers to track their time and provide detailed timesheets and task descriptions. Therefore, while it may not always be feasible for researchers to keep an exact record of their time, this study relies on the moral integrity of researchers to avoid exaggeration their contributions for personal gain.

- **Time VS Expertise**: Another limitation involves the varying levels of expertise among authors, as the same task can require different amounts of time depending on the individual's skills and experience. For instance, one person might write 1,000 words in an hour, while another might need several hours to accomplish the same task. A young researcher, for example, may take more time to write than a senior professor due to differences in experience. This study assumes that experience and hard work lead to expertise in different parts of the publication process, and authorship reflects the time invested and the value of that time. If one person can complete the same task in less time, it indicates a higher value for their time, which should be reflected in the valuation of their contribution. However, gender differences must also be considered. Women often have greater caregiving and service responsibilities than men, leaving them less time to dedicate to science. As a result, men might report higher time contributions. This study assumes that the time invested in the publication is part of regular working hours, generally around 40 h a week, with some flexibility in academic institutions. Authors are not expected to work beyond these working hours, so gender-based differences in time investment are not considered in this approach. Nevertheless, this issue should be considered during promotions, recognizing that women may have less time for research due to caregiving responsibilities. Therefore, publication thresholds should not be the same for both genders, to normalize these differences and ensure a fair evaluation in academic promotions.
- **Normalized Compensation**: The value of the time invested by each potential author also has certain limitations. First, it is important to determine whether a potential author is paid or unpaid. For paid authors, the fairness of financial compensation, both inter-geographically and intra-geographically, should be considered. For unpaid contributors, such as students, graduate students, or other unpaid researchers working on their dissertations, this study assigns an equivalent salary based on the market rate that would apply if a commercial entity hired someone for the same work. This involves determining the standard hourly rate for similar work within an academic context and applying that rate to the time invested by the unpaid potential author. In cases of international collaborations where potential authors have different salaries for the same work, two solutions are proposed. One is to use Purchasing Power Parity (PPP) to normalize salaries or hourly rates across different locations. The other is to use the maximum salary for the same position across locations. For example, if there are two professors from different countries with different salaries, the maximum salary of that position would be applied to both. There may also be cases where potential authors have different salaries for the same work due to discrimination in promotion or other factors based on gender and ethnicity. In such cases, if normalization is required, the pay disparity can be addressed by assigning the same salary to authors who are considered to be at the same level, regardless of their positions that might affect their salaries. This adjustment ensures that salary differences due to gender and ethnicity do not impact the valuation of their contributions to the publication. This approach aims to provide a fair assessment of contributions, making adjustments for salary disparities when necessary.
- **Multiple Affiliations and Funding Sources**: In calculating the hourly compensation, an author may have multiple affiliations, making it challenging to determine the actual salary from each organization for the work done on the manuscript. It is common for an author to be affiliated with several organizations and receive different compensation for their time at each one. In this study, a simplified approach is adopted where the total monthly salary from all sources is

combined for each author. This combined monthly salary is then divided by the total working hours per month, typically based on a 40-hour working week. Another situation arises when multiple funding agencies, potentially located in different countries, are listed in a paper. In such cases, funding amounts are first normalized using PPP to standardize the funds across different locations. The final compensation for the author is then calculated based on a 40-hour working week.

- **Lack of Data and Culture to Track Time**: In many academic institutions, detailed records of the time spent on different research activities, including publications, are not consistently available. While some disciplines or specific higher education systems may routinely track time, this is not a universal practice. Time tracking is more likely to occur in contexts where external funding, such as grants from the European Union, mandates the use of timesheets. However, in many institutions, the culture of time recording is not widespread and varies significantly across disciplines. The concept of tracking 'time invested' in research is often criticized for promoting a culture of performativity, where researchers feel pressured to quantify their work in ways that might not align with the ethos of academic freedom. Research should ideally be driven by intrinsic motivation and intellectual curiosity rather than rigid time-keeping. However, there have been instances where researchers, either willingly or due to external pressures, have worked excessive hours on their projects. In such cases, keeping time records can serve as a useful tool for balancing workloads, ensuring that researchers maintain a healthy work-life balance. When funding agencies require time tracking, it is not necessarily to evaluate performance but to ensure transparency and prevent overwork. This can protect researchers from being exploited by ensuring that working hours are reasonable. Despite the historical lack of a time-tracking culture in academia, there is a growing recognition of the importance of work-life balance. Institutions are increasingly acknowledging that while research is vital, it should be conducted in a way that supports researchers' personal well-being. This shift reflects a broader change in academic culture toward healthier and more sustainable working practices.

There is also the issue of salary differences across different positions. Often, those involved in primary research or preparing manuscript drafts, such as graduate students, postdocs, laboratory assistants, and research assistants, are among the lowest paid. This is not necessarily the case in developed countries; for instance, at a Swedish technical university, the average monthly salary for a professor is around 82,000 SEK, while a doctoral student earns about 34,000 SEK. In some universities, salaries may vary significantly, with senior doctors potentially earning more than others in the medical discipline. A rule of thumb used in this study is that if the minimum and maximum salaries of potential authors differ by more than a factor of three, it indicates underpayment. In such cases, normalization rules can be applied. First, ensuring that no salary is less than 33% of the maximum salary. If any potential author earns less, their salary will be adjusted to 33% of the maximum salary. Second, normalize salaries by using a formula that calculates the salary of each author with its salary in addition to the average salary of the authors' group. Ultimately, it is up to the potential authors to decide which method to use, but the guiding principle is that the minimum and maximum salaries should not differ by more than a factor of three. If they do, the contributions cannot be adequately compensated by time alone due to the significant discrepancy.

There have been numerous previous attempts to objectively determine authorship in multi-author papers. Various authors have developed several empirical and semi-quantitative approaches for quantifying authorship contributions in an objective manner (Ahmed et al. 1997; Bhopal et al. 1997; Clement 2014; Hunt 1991; Resnik 1997; Schmidt 1987; Sheskin 2006; Tscharntke et al. 2007; Warrender 2016). These approaches often rely on different aspects of the manuscript process, such as conception and design, data acquisition, analysis and interpretation, and manuscript preparation and stewardship. Other approaches also consider the perceptions of potential authors regarding each other's contributions, compiling, averaging, and ranking these perceptions quantitatively. However, in this study, the parameters are based on quantitatively measurable factors,

rather than those that require subjective discussion, which can be dominated by individuals with power and influence. Subjective parameters often lead to decisions made by dominant authors, leaving little room for disagreement since these contributions cannot be independently and objectively evaluated. This can result in biased decisions and prevent those with less power from effectively voicing their contributions.

2.3. Developing quantitative authorship approach

As outlined in Section 2.2, this study focuses on two primary parameters: the evaluation of the time each contributor invests in the publication and the assessment of the value of their time based on their normalized hourly compensation. It is important to highlight that this approach is based on the compensatory principle, meaning the two parameters are treated as interdependent and equally important; progress in one parameter can offset a shortfall in the other. For instance, investing more time can compensate for a lower salary, and a higher salary can compensate for less time invested. This approach ensures that contributors must strive to maintain a balance in both parameters to improve their overall contribution to the publication.

The steps for determining authorship are described below and summarized in Table 1:

Step 1: Compile a list of all contributors: To define the scope of authorship, this step involves listing all contributors, including individuals and organizations as outlined in Section 2.1. All contributors should be included in the acknowledgment section without any omission to avoid ghost authorship.

Step 2: Compile a list of all potential authors: All the contributors who qualify as potential authors as per Section 2.1 are listed in this step. The primary criterion for distinguishing between a contributor and a potential author is accountability. It is based on the principle that contributions without understanding can lead to acknowledgment but does not qualify for authorship.

Step 3: Calculate invested time: This step involves calculating the amount of time invested by each potential author in the publication. If a potential author's contribution can be used in multiple publications, then time allocation must be used to estimate the portion of time specifically devoted to the publication under consideration. This estimation should be based on the primary beneficiary of the contribution and how the time is distributed across the different publications.

Step 4: Compile compensation data: To collect financial data for all potential authors of the publication, determine each individual's hourly rate of compensation either based on their monthly salary or other equivalent data sources. For contributors with different salaries for the same work in different geographical locations, Purchasing Power Parity (PPP) can be used to normalize the salaries/ hourly compensation rates. This step also includes normalization for variations related to gender, ethnicity, or position, if necessary, as outlined in Section 2.2.

Step 5: Calculate the total value of each potential author: To determine the value of each potential author's contribution, multiply the time they invested by their normalized hourly rate. The sum of these individual values represents the total value of the publication. Each potential author's percentage contribution is then calculated based on their value relative to the total value of the publication.

Step 6: Benchmark authorship contribution criteria: Authors can collectively decide on a benchmark contribution value, typically ranging from 0% to 100%. It is recommended that a minimum contribution of at least 5% be required to qualify as an author, although this threshold can be adjusted based on the consensus of the potential authors. Those whose contributions exceed this benchmark are considered authors, while those who do not meet the benchmark are acknowledged.

Step 7: Determine the order of authorship: After selecting the authors, the order is determined based on the magnitude of each author's contribution. Authors with the highest contributions are listed first, followed by others in descending order according to their level of contribution.

Table 1. Determining authorship using a systematic quantitative approach.

Publication under consideration													
Contributor	Contributor Type Type*	Potential authors Qualify	Time invested		Hourly Salary/ financial compensation		Normalised hourly compensation		Potential authors contribution		Authors contribution		Authorship ranking
			Value	Unit	Value	Unit	Value	Unit	Contribution	Unit	%	Qualify	
Contributor 1	I	Yes	T1	Hours	V1	$/h	N1	$/h	T1.N1	$	P1	Yes	P highest
Contributor 2	O	No											
…	…	…	…	Hours	…	$/h	…	$/h	…	$	…	…	
Contributor n	I	Yes	Tn	Hours	Vn	$/h	Nn	$/h	Tn. Nn	$	Pn	Yes	P lowest
Total									**Total T.N**		**B****		

*Type: I is individual and O is organization, B**: Benchmark contribution, Publication refer to all types of scientific contributions including original research papers, reports, reviews, editorials, case studies, letters, non-research articles, etc.

Table 2. Extra time needed by a doctoral student to be on the same level as other academic faculty in a publication.

Employment category	Average Salary* (SEK/month)	Extra time to equate contribution by doctoral student (months)
Professor	81 581	1.40
Associate Professor	65 771	0.93
Senior Lecturer	58 361	0.72
Lecturer	46 564	0.37
Researcher	46 832	0.38
Postdoc	39 875	0.17
PhD Candidate	34 009	
Project Assistant	30 615	−0.10

* Average salaries in Swedish technical universities in 2023.

This quantification-based approach complements qualitative discussions among potential authors regarding authorship, providing a structured foundation for these conversations. This helps potential authors reach a consensus on authorship and the order of authorship, preventing injustices and ensuring that all contributors have a voice, regardless of their power and influence. In some cases, factors such as the value of the contribution, personal needs like promotional requirements, seniority, and the need to support young researchers can be part of the qualitative discussion to finalize the authorship and order of authorship. However, the quantification serves as the baseline for these discussions.

To explain the compensatory principle and the nature of two parameters, an example within the academic context, particularly Swedish academia, is provided. Table 2 illustrates the additional time a doctoral student needs to equate their contribution to that of a senior researcher or other types of employment. In research settings, doctoral students often perform a significant portion of the work under the supervision or collaboration of senior faculty. Due to their relative inexperience, doctoral students generally require more time to achieve similar outcomes. For instance, if a senior researcher can complete a task in one hour, a doctoral student might need several hours to accomplish the same task. According to the quantification framework in Table 2, compared to a professor, a doctoral student's contributions are considered balanced if they spend an additional 1.4 months relative to the professor's 1 month.

In the European context, especially in European projects, it is common for doctoral students to be allocated 80% of the budgeted time, with the main supervisor typically receiving 15% and the co-supervisor 5%. Given these budget allocations and corresponding salaries, it is reasonable that doctoral students to often the main authors. This approach ensures that the academic contributions of all researchers are fairly evaluated and that the unique challenges faced by less experienced researchers are acknowledged. By recognizing the additional time and effort required by doctoral students, this framework provides a balanced and equitable assessment of contributions across different levels of experience.

3. Discussion

There is a prevailing view in the field of authorship research that decisions regarding authorship should be made by the authors themselves, as this is considered the most effective method for decision-making. Indeed, this approach is commonly used by most researchers. However, while this approach might work well in an ideal world, the current research landscape, with its emphasis on publication and co-authorship as a path to career advancement, often favors those with power and influence. This can lead to unjust outcomes for contributors who may be deserving of authorship but lack a voice in the decision-making process. For example, Khalifa, El-Hawary, and Sadek (2021) highlighted the issue of undermining young researchers' contributions in their analysis of authorship trends in the Egyptian Orthopaedic Journal. Out of 305 studies analyzed where the degree of the first author was reported, 99% had a first author with an M.D. degree (senior researchers), while only 1% had a first author with a master's degree (young researchers).

Another perspective emphasizes that the timing of the authorship decision is crucial and should ideally be made before the manuscript preparation begins. In the context of multi-authorship, research often starts with a core group of contributors, and as the project evolves, additional experts may be brought in to help achieve the study's objectives. Deciding authorship before the manuscript is prepared can be challenging due to the iterative nature of research, which involves multiple drafts and revisions. As new contributors are added, authorship decisions need to be revisited and communicated to all parties involved, including those newly added, to determine if they wish to be considered potential authors. In this evolving process, everyone involved may initially be considered potential authors. However, the final authorship should accurately reflect the actual contributions made during the manuscript's development. While initial agreements on potential authorship are important, the final list and order of authors should be based on the extent of each contributor's input. This study suggests that although the timing of authorship decisions is critical for identifying potential contributors early on, the final authorship should be determined on quantitative criteria before the manuscript is submitted.

There are also concerns regarding the reliability and trustworthiness of the time and compensation data used in determining authorship. Potential biases and limitations associated with these parameters are outlined in Section 2.2. However, errors or missing information can occur while calculating these parameters. It is acknowledged that there may be some variability in these data, but this is not expected to deviate significantly from reality. This is primarily because, in a multi-author study, authors generally have experience and judgment to estimate the potential time required for various parts of the study, and there are checks and balances in place. Scientific integrity among authors, combined with an awareness that others may have a better judgment regarding the time needed for tasks like data collection or analysis, helps ensures that estimates are reasonably accurate. Co-authors are also typically aware of the ongoing tasks and time commitments of their colleagues, which reduces the likelihood of significant deviations from reality in their estimates. Quantifying time and compensation in terms of hours and hourly compensation is not likely to deviate too far from reality, and these figures can be easily verified. If an author is involved in multiple tasks, they are unlikely to report an excessive number of hours that are not feasible. While vague terms like 'low' and 'high' can be subjective in qualitative discussions, quantifying these can be more objective, as there are checks and balances since potential authors are usually aware of each other's commitments and ongoing projects. It is also unjustified to claim that someone else performing the same task would take more time, as the expertise that reduces the time to do a task is reflected in the salary. With experience, individuals receive promotions and higher salaries, which indicates their efficiency. Therefore, it is reasonable to assume that reported time and compensation data cannot be too far from reality. While errors and missing information can occur, they can be adjusted using estimated values based on informed judgment. This approach ensures the data is recorded with reasonable accuracy rather than deviating significantly from reality. A quantitative approach supports qualitative discussions, so it needs to be reasonably accurate rather than highly precise to effectively support qualitative insights.

There may also be a perspective that the parameters selected in this study, while measurable, are not necessarily the best markers of effort and contribution in a publication. The concern may be that the quantification approach could exacerbate disparities in science, making it more difficult for women and people of color to advance their careers (Ceci et al. 2014; Toutkoushian 1999). Using hourly rates to calculate authorship may reinforce existing disparities. Since females in academia typically earn less than males, they may always be rated lower than males on the recommended approach (Ash et al. 2004). This could decrease the number of women qualifying for authorship and achieving higher-ranking authorship positions. The same issue can apply to Black and Latino authors (Strayhorn 2010). Additionally, relying on salary also ignores the fact that pay rates are influenced by years of service, with fewer women in senior positions because research has only recently become more accessible to them (Hill, Corbett, and St Rose 2010; Winkler 2000). Differences in full-time vs. part-time faculty status and race and ethnicity also impact earnings. Junior

researchers, by definition, earn lower salaries than senior ones, and senior faculty might be victims of salary compression, meaning they may not earn as much as mid-level faculty members. This could result in age discrimination when measuring authorship credits under the recommended approach. This study acknowledges all these valid concerns but aims to give a voice to authors who are suffering from these disparities and may not have a say in the decision-making process. The study assumes that faculty members in the same position will receive the same pay, regardless of gender. It also assumes there is no discrimination in promotion based on gender and ethnicity and that promotions will be normalized to compensate for the fact that females often have caregiving responsibilities and may need to take work leave during their careers. While historical disparities in academia and society need to be addressed through concerted efforts, but it is also crucial to ensure equality and fairness for all authors in a publication, regardless of their differences. Authorship should be based on each individual's contribution, time invested, and the value of their time.

While the approach outlined in this study can technically be applied to megascience papers, it is not considered feasible for such contexts. The primary focus of this study is to provide a voice to coauthors with less power and influence in the authorship decision-making process, a concern that is not as relevant in megascience papers. Megascience papers are primarily designed to reflect a consensus among authors on a particular topic rather than to highlight individual contributions. These papers typically aim to show who is involved in the topic, with the first few authors usually being those who designed the paper and led the collaboration. In such papers, authorship decisions are less likely to be dominated by individuals with power and influence because the involvement of numerous coauthors provides a system of checks and balances. Thus, there is limited possibility to deny authorship unfairly, and contributions are generally recognized equitably.

While the proposed approach to authorship is valuable, it cannot completely eliminate inappropriate or unethical behavior among some authors, nor can it entirely prevent conflicts or research misconduct. Therefore, all parties involved in the publication process, including those who generate the research, those who facilitate its dissemination, and those who consume the published work, should recognize the importance of research integrity as the foundation of the research. To achieve this, researchers must undergo training through educational courses that emphasize the moral and ethical aspects of authorship (Abbott et al. 2020; Macrina 2011; Nicholas et al. 2017). They should also become familiar with the authorship policies and guidelines of different publications (Sara et al. 2020). Reviewers and editors can contribute by defining clear authorship criteria through editorial policies and by preventing ambiguous authorship by requiring a list of each authors' contributions (Gasparyan 2011; McNutt et al. 2018; Teixeira da Silva and Dobránszki 2016a). Adopting an objective and transparent approach, as suggested in this study, alongside relevant policies and the discouragement of dishonest attribution of authorship, can help prevent misconduct at various stages of the publication process, from initial writing phases to revisions. Organizations and institutions should also develop educational materials, guidelines, policy statements, and training programs that address authorship issues, alongside other ethical and research integrity concerns.

4. Conclusions

Authorship issues in publications have become more apparent in recent times due to the evolving nature of research, characterized by increased multidimensionality, multidisciplinary collaboration, and a strong influence of research funding, which often hinges on the number of publications by a researcher. This environment has led to a commercial conflict of interest, where researchers may seek authorship in publications to enhance their recognition and collaboration opportunities. The pervasive 'Publish or Perish' mentality further exacerbates these issues. In the absence of a global consensus on authorship criteria, this study proposes an approach to determine authorship in any publication by considering two parameters: first, evaluating the time invested by each

contributor in the publication, and second, assessing the normalized value of their time. By analyzing contributions based on these parameters, a predefined threshold is set to determine authorship, with contributors falling below this cutoff being acknowledged for their valuable contributions.

The authorship approach proposed in this study is versatile and can be applied to any type of publication. It is based on two key principles. First, to avoid ghost contributions, all contributors should be clearly listed either as authors or in the acknowledgments, ensuring there is no ambiguity about their contributions. Second, all authors should be able to take accountability for the entire publication rather than just parts of it and be prepared to defend it individually, if necessary, rather than relying on other authors to address readers' concerns. This approach ensures that contributors receive the recognition they deserve and are accountable for the content they publish in the face of conflict. The main aim of the proposed quantification approach is to support the qualitative discussions among potential authors regarding authorship, helping them reach a consensus on authorship and authorship order. This helps prevent injustices and ensures that all contributors have a voice, regardless of their power and influence.

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Data availability statement

All data generated during this study are included in this published article.

Disclosure statement

During the preparation of this work the author(s) used ChatGPT 3.5 in order to improve grammar. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

ORCID

Rahul Aggarwal http://orcid.org/0000-0002-3000-8893

References

Abbott, L. E., A. Andes, A. C. Pattani, and P. A. Mabrouk. 2020. "Authorship not Taught and not Caught in Undergraduate Research Experiences at a Research University." *Science and Engineering Ethics* 26 (5): 2555–99. https://doi.org/10.1007/s11948-020-00220-6.

Ahmed, S. M., C. A. Maurana, J. A. Engle, D. E. Uddin, and K. D. Glaus. 1997. "A Method for Assigning Authorship in Multiauthored Publications." *Family Medicine-Kansas City* 29:42–44.

Ali, M. J., and A. Djalilian. 2022. "Readership Awareness Series – Paper 1: Ghost Authorship." *Seminars in Ophthalmology* 37 (7-8): 793–4. https://doi.org/10.1080/08820538.2022.2112852.

Angell, M. 1986. "Publish or Perish: A Proposal." *Annals of Internal Medicine* 104 (2): 261–62. https://doi.org/10.7326/0003-4819-104-2-261.

Ash, A. S., P. L. Carr, R. Goldstein, and R. H. Friedman. 2004. "Compensation and Advancement of Women in Academic Medicine: Is There Equity?" *Annals of Internal Medicine* 141 (3): 205–12. https://doi.org/10.7326/0003-4819-141-3-200408030-00009.

Avula, J., and H. Avula. 2015. "Authors, Authorship Order, the Moving Finger Writes." *Journal of Indian Society of Periodontology* 19 (3): 258. https://journals.lww.com/jisp/fulltext/2015/19030/authors,_authorship_order,_the_moving_finger.5.aspx

Baerlocher, M. O., M. Newton, T. Gautam, G. Tomlinson, and A. S. Detsky. 2007. "The Meaning of Author Order in Medical Research." *Journal of Investigative Medicine* 55 (4): 174–80. https://doi.org/10.2310/6650.2007.06044.

Bates, T., A. Anić, M. Marušić, and A. Marušić. 2004. "Authorship Criteria and Disclosure of Contributions: Comparison of 3 General Medical Journals with Different Author Contribution Forms." *Jama* 292 (1): 86–88. https://doi.org/10.1001/jama.292.1.86.

Bennett, D. M., and D. M. Taylor. 2003. "Unethical Practices in Authorship of Scientific Papers." *Emergency Medicine* 15 (3): 263–70. https://doi.org/10.1046/j.1442-2026.2003.00432.x.

Bhopal, R., J. Rankin, E. McColl, R. Stacy, P. Pearson, E. Kaner, L. Thomas, B. Vernon, and H. Rodgers. 1997. "Authorship. Team Approach to Assigning Authorship Order is Recommended." *BMJ* 314 (7086): 1009. https://doi.org/10.1136/bmj.314.7086.1009.

Bornmann, L., and H. D. Daniel. 2009. "The State of h Index Research: Is the h Index the Ideal Way to Measure Research Performance?" *EMBO Reports* 10 (1): 2–6. https://doi.org/10.1038/embor.2008.233.

Bornmann, L., and W. Marx. 2014. "How Should the Societal Impact of Research be Generated and Measured? A Proposal for a Simple and Practicable Approach to Allow Interdisciplinary Comparisons." *Scientometrics* 98 (1): 211–19. https://doi.org/10.1007/s11192-013-1020-x.

Boudreau, M.-C., D. Gefen, and D. W. Straub. 2001. "Validation in Information Systems Research: A State-of-the-Art Assessment." *MIS Quarterly* 25:1–16. https://doi.org/10.2307/3250956.

Bruce, C. 2003. "Information Literacy as a Catalyst for Educational Change: A Background Paper." International Information Literacy Conferences and Meetings.

Carpenter, C. R., D. C. Cone, and C. C. Sarli. 2014. "Using Publication Metrics to Highlight Academic Productivity and Research Impact." *Academic Emergency Medicine* 21 (10): 1160–72. https://doi.org/10.1111/acem.12482.

Ceci, S. J., D. K. Ginther, S. Kahn, and W. M. Williams. 2014. "Women in Academic Science: A Changing Landscape." *Psychological Science in the Public Interest* 15 (3): 75–141. https://doi.org/10.1177/1529100614541236.

Clarke, B. L. 1964. "Multiple Authorship Trends in Scientific Papers." *Science* 143 (3608): 822–24. https://doi.org/10.1126/science.143.3608.822.

Claxton, L. D. 2005. "Scientific Authorship: Part 2. History, Recurring Issues, Practices, and Guidelines." *Mutation Research/Reviews in Mutation Research* 589 (1): 31–45. https://doi.org/10.1016/j.mrrev.2004.07.002.

Clement, T. P. 2014. "Authorship Matrix: A Rational Approach to Quantify Individual Contributions and Responsibilities in Multi-Author Scientific Articles." *Science and Engineering Ethics* 20 (2): 345–61. https://doi.org/10.1007/s11948-013-9454-3.

Cobey, K. D., Z. Monfaredi, E. Poole, L. Proulx, D. Fergusson, and D. Moher. 2021. "Editors-in-Chief Perceptions of Patients as (Co) Authors on Publications and the Acceptability of ICMJE Authorship Criteria: A Cross-Sectional Survey." *Research Involvement and Engagement* 7 (1): 39. https://doi.org/10.1186/s40900-021-00290-1.

Cokol, M., F. Ozbay, and R. Rodriguez-Esteban. 2008. "Retraction Rates are on the Rise." *EMBO Reports* 9 (1): 2. https://doi.org/10.1038/sj.embor.7401143.

Costas, R., and M. Bordons. 2011. "Do age and Professional Rank Influence the Order of Authorship in Scientific Publications? Some Evidence from a Micro-Level Perspective." *Scientometrics* 88 (1): 145–61. https://doi.org/10.1007/s11192-011-0368-z.

da Silva, J. T., and J. Dobránszki. 2013. "Should the Hardy–Littlewood Axioms of Collaboration be Used for Collaborative Authorship." *Asian Australasian Journal of Plant Science and Biotechnology* 7:72–75.

Dearing, J. W., K. F. Kee, and T. Q. Peng. 2012. "Historical Roots of Dissemination and Implementation Science." In *Dissemination and Implementation Research in Health: Translating Science to Practice*, vol. 55, edited by Ross C. Brownson, Graham A. Colditz, and Enola K. Proctor, 71. Oxford: Oxford University Press. https://doi.org/10.1093/oso/9780197660690.003.0003.

Dimitroulis, G. 2011. "Getting Published in Peer-Reviewed Journals." *International Journal of Oral and Maxillofacial Surgery* 40 (12): 1342–45. https://doi.org/10.1016/j.ijom.2011.11.012.

Dolmans, S. A. M., B. Walrave, S. Read, and N. van Stijn. 2022. "Knowledge Transfer to Industry: How Academic Researchers Learn to Become Boundary Spanners During Academic Engagement." *The Journal of Technology Transfer* 47 (5): 1422–50. https://doi.org/10.1007/s10961-021-09882-1.

Dreyfuss, R. C. 2000. "Collaborative Research: Conflicts on Authorship, Ownership, and Accountability." *Vanderbilt Law Review* 53:1159.

Editorial Policy Committee, C. o. S. E. 2023. *Recommendations for Promoting Integrity in Scientific Journal Publications*. Mullica Hill. https://www.councilscienceeditors.org/recommendations-for-promoting-integrity-in-scientific-journal-publications

Fanelli, D. 2016. "Set up a 'Self-Retraction' System for Honest Errors." *Nature* 531 (7595): 415–. https://doi.org/10.1038/531415a.

Feeser, V. R., and J. R. Simon. 2008. "The Ethical Assignment of Authorship in Scientific Publications: Issues and Guidelines." *Academic Emergency Medicine* 15 (10): 963–969.

Foray, D. 1997. "Generation and Distribution of Technological Knowledge: Incentives, Norms, and Institutions." In *Systems of Innovation: Technologies, Institutions and Organizations*, 64–85. London: Routledge. https://doi.org/10.4324/9780203357620.

Gasparyan, A. Y. 2011. "Familiarizing with Science Editors' Associations." *Croatian Medical Journal* 52 (6): 735–9. https://doi.org/10.3325/cmj.2011.52.735.

Gasparyan, A. Y., L. Ayvazyan, H. Blackmore, and G. D. Kitas. 2011. "Writing a Narrative Biomedical Review: Considerations for Authors, Peer Reviewers, and Editors." *Rheumatology International* 31 (11): 1409–17. https://doi.org/10.1007/s00296-011-1999-3.

Gasparyan, A. Y., L. Ayvazyan, and G. D. Kitas. 2013. "Authorship Problems in Scholarly Journals: Considerations for Authors, Peer Reviewers and Editors." *Rheumatology International* 33 (2): 277–84. https://doi.org/10.1007/s00296-012-2582-2.

Grech, V. 2022. "Publish or Perish, Information Overload, and Journal Impact Factors – A Conflicting Tripod of Forces." *Saudi Journal of Anaesthesia* 16 (2): 204–207. https://doi.org/10.4103/sja.sja_632_21.

Greene, M. 2007. "The Demise of the Lone Author." *Nature* 450 (7173): 1165. https://doi.org/10.1038/4501165a.

Gülen, S., S. Fonnes, K. Andresen, and J. Rosenberg. 2020. "More Than One-Third of Cochrane Reviews had Gift Authors, Whereas Ghost Authorship was Rare." *Journal of Clinical Epidemiology* 128:13–19. https://doi.org/10.1016/j.jclinepi.2020.08.004.

Guraya, S. Y., R. I. Norman, K. I. Khoshhal, S. S. Guraya, and A. Forgione. 2016. "Publish or Perish Mantra in the Medical Field: A Systematic Review of the Reasons, Consequences and Remedies." *Pakistan Journal of Medical Sciences* 32 (6): 1562. https://doi.org/10.12669/pjms.326.10490.

Gureev, V. N., I. G. Lakizo, and N. A. Mazov. 2019. "Unethical Authorship in Scientific Publications (A Review of the Problem)." *Scientific and Technical Information Processing* 46 (4): 219–32. https://doi.org/10.3103/S0147688219040026.

Helgesson, G., and S. Eriksson. 2019. "Authorship Order." *Learned Publishing* 32 (2): 106–12. https://doi.org/10.1002/leap.1191.

Hill, C., C. Corbett, and A. St Rose. 2010. *Why So Few? Women in Science, Technology, Engineering, and Mathematics*. 1111 Sixteenth Street NW, Washington, DC 20036: American Association of University Women.

Holcombe, A. O. 2019. "Contributorship, not Authorship: Use CRediT to Indicate Who Did What." *Publications* 7 (3): 48. https://www.mdpi.com/2304-6775/7/3/48

Huang, M.-h., H.-T. Hsieh, and C.-S. Lin. 2016. "The Co-First and Co-Corresponding Author Phenomenon in the Pharmacy and Anesthesia Journals." *Proceedings of the Association for Information Science and Technology* 53 (1): 1–4. https://doi.org/10.1002/pra2.2016.14505301138.

Hunt, R. 1991. "Trying an Authorship Index." *Nature* 352 (6332): 187. https://doi.org/10.1038/352187a0.

Jasanoff, S. 2011. "Quality Control and Peer Review in Advisory Science." In *The Politics of Scientific Advice: Institutional Design for Quality Assurance*, edited by J. Lentsch and P. Weingart, 19–35. Cambridge: Cambridge University Press.

Johann, D. 2022. "Perceptions of Scientific Authorship Revisited: Country Differences and the Impact of Perceived Publication Pressure." *Science and Engineering Ethics* 28 (2): 10. https://doi.org/10.1007/s11948-021-00356-z.

Johann, D., and S. J. Mayer. 2019. "The Perception of Scientific Authorship Across Domains." *Minerva* 57 (2): 175–96. https://doi.org/10.1007/s11024-018-9363-3.

Jones, J. W., and L. B. McCullough. 2015. "Is a Gift Authorship Really a Grift Authorship?" *Journal of Vascular Surgery* 61 (4): 1092–93. https://doi.org/10.1016/j.jvs.2015.02.006.

Justin, G. A., S. C. Miller, B. Tsou, X. Li, B. Purt, M. J. Fliotsos, J. Zhao, et al. 2022. "Ghost and Honorary Authorship in Ophthalmology: A Cross-Sectional Survey." *American Journal of Ophthalmology* 240:67–78. https://doi.org/10.1016/j.ajo.2022.02.012.

Juyal, D., V. Thawani, S. Thaledi, and A. Prakash. 2014. "The Fruits of Authorship." *Education for Health* 27 (2): 217–20. https://doi.org/10.4103/1357-6283.143777.

Kearney, M., M. Downing, and E. A. Gignac. 2024. "Research Integrity and Academic Medicine: The Pressure to Publish and Research Misconduct." *Journal of Osteopathic Medicine* 124 (5): 187–94. https://doi.org/10.1515/jom-2023-0211.

Khalifa, A. A. 2022. "Losing Young Researchers in the Authorship Battle, Under-Reported Casualties." *Ethics, Medicine and Public Health* 20:100735. https://doi.org/10.1016/j.jemep.2021.100735.

Khalifa, A. A., A. S. El-Hawary, and A. E. Sadek. 2021. "Authorship Trends in the Egyptian Orthopedic Journal (from 2012 to 2020), as an Example of a Specialized Egyptian Medical Journals." *Bulletin of the National Research Centre* 45 (1): 72. https://doi.org/10.1186/s42269-021-00531-z.

Khezr, P., and V. Mohan. 2022. "The Vexing but Persistent Problem of Authorship Misconduct in Research." *Research Policy* 51 (3): 104466. https://doi.org/10.1016/j.respol.2021.104466.

Khoshpouri, P., P. Khoshpouri, E. Beheshtian, and D. M. Yousem. 2019. "The Policy of Co–First Authorship and Co–Senior Authorship in Radiology Journals." *Journal of the American College of Radiology* 16 (10): 1491–98. https://doi.org/10.1016/j.jacr.2019.06.011.

Lake, D. A. 2010. "Who's on First? Listing Authors by Relative Contribution Trumps the Alphabet." *PS: Political Science & Politics* 43 (1): 43–47. https://doi.org/10.1017/S104909651099080X.

Lapidow, A., and P. Scudder. 2019. "Shared First Authorship." *Journal of the Medical Library Association* 107 (4): 618–20. https://doi.org/10.5195/jmla.2019.700.

Larivière, V., D. Pontille, and C. R. Sugimoto. 2021. "Investigating the Division of Scientific Labor Using the Contributor Roles Taxonomy (CRediT)." *Quantitative Science Studies* 2 (1): 111–28. https://doi.org/10.1162/qss_a_00097.

Levitt, J. M., and M. Thelwall. 2013. "Alphabetization and the Skewing of First Authorship Towards Last Names Early in the Alphabet." *Journal of Informetrics* 7 (3): 575–82. https://doi.org/10.1016/j.joi.2013.03.002.

Lissoni, F., and F. Montobbio. 2015. "Guest Authors or Ghost Inventors? Inventorship and Authorship Attribution in Academic Science." *Evaluation Review* 39 (1): 19–45. https://doi.org/10.1177/0193841X13517234.
Liu, X. Z., and H. Fang. 2014. "The Impact of Publications from Mainland China on the Trends in Alphabetical Authorship." *Scientometrics* 99 (3): 865–79. https://doi.org/10.1007/s11192-013-1219-x.
Macfarlane, B. 2017. "The Ethics of Multiple Authorship: Power, Performativity and the Gift Economy." *Studies in Higher Education* 42 (7): 1194–210. https://doi.org/10.1080/03075079.2015.1085009.
Macrina, F. L. 2011. "Teaching Authorship and Publication Practices in the Biomedical and Life Sciences." *Science and Engineering Ethics* 17 (2): 341–54. https://doi.org/10.1007/s11948-011-9275-1.
Manton, E. J., and D. E. English. 2008. "An Empirical Study of Gift Authorships in Business Journals." *Journal of Education for Business* 83 (5): 283–87. https://doi.org/10.3200/JOEB.83.5.283-287.
Marco, C. A. 2004. "Who Wrote This Paper? Basics of Authorship and Ethical Issues." *Academic Emergency Medicine* 11 (1): 76–77. https://doi.org/10.1197/j.aem.2003.08.015.
Marušić, M., J. Božikov, V. Katavić, D. Hren, M. Kljaković-Gašpić, and A. Marušić. 2004. "Authorship in a Small Medical Journal: A Study of Contributorship Statements by Corresponding Authors." *Science and Engineering Ethics* 10 (3): 493–502. https://doi.org/10.1007/s11948-004-0007-7.
McNutt, M. K., M. Bradford, J. M. Drazen, B. Hanson, B. Howard, K. H. Jamieson, V. Kiermer, et al. 2018. "Transparency in Authors' Contributions and Responsibilities to Promote Integrity in Scientific Publication." *Proceedings of the National Academy of Sciences* 115 (11): 2557–60. https://doi.org/10.1073/pnas.1715374115.
Mertkan, S., G. Onurkan Aliusta, and H. Bayrakli. 2022. "Pressured to Publish: Stories of Inexperienced Researchers." *Journal of Organizational Change Management* 35 (3): 603–15. https://doi.org/10.1108/JOCM-08-2021-0239.
Meursinge Reynders, R., G. ter Riet, N. Di Girolamo, and M. Malički. 2022. "Honorary Authorship in Health Sciences: A Protocol for a Systematic Review of Survey Research." *Systematic Reviews* 11 (1): 57. https://doi.org/10.1186/s13643-022-01928-1.
Moffatt, B. 2011. "Responsible Authorship: Why Researchers Must Forgo Honorary Authorship." *Accountability in Research* 18 (2): 76–90. https://doi.org/10.1080/08989621.2011.557297.
Mondal, H., S. Mondal, and R. Haldar. 2023. "Criteria to be an Author of a Manuscript: Time to Revisit the ICMJE Criteria and CRediT." *Journal of Anaesthesiology Clinical Pharmacology* 39 (4): 674–75. https://journals.lww.com/joacp/fulltext/2023/39040/criteria_to_be_an_author_of_a_manuscript__time_to.38.aspx
Mowatt, G., L. Shirran, J. M. Grimshaw, D. Rennie, A. Flanagin, V. Yank, G. MacLennan, P. C. Gøtzsche, and L. A. Bero. 2002. "Prevalence of Honorary and Ghost Authorship in Cochrane Reviews." *Jama* 287 (21): 2769–71. https://doi.org/10.1001/jama.287.21.2769.
Nath, S. B., S. C. Marcus, and B. G. Druss. 2006. "Retractions in the Research Literature: Misconduct or Mistakes?" *Medical Journal of Australia* 185 (3): 152–4. https://doi.org/10.5694/j.1326-5377.2006.tb00504.x.
Ngai, S., J. L. Gold, S. S. Gill, and P. A. Rochon. 2005. "Haunted Manuscripts: Ghost Authorship in the Medical Literature." *Accountability in Research* 12 (2): 103–14. https://doi.org/10.1080/08989620590957175.
Nicholas, D., B. Rodríguez-Bravo, A. Watkinson, C. Boukacem-Zeghmouri, E. Herman, J. Xu, A. Abrizah, and M. Świgoń. 2017. "Early Career Researchers and Their Publishing and Authorship Practices." *Learned Publishing* 30 (3): 205–17. https://doi.org/10.1002/leap.1102.
O'Brien, J., M. O. Baerlocher, M. Newton, T. Gautam, and J. Noble. 2009. "Honorary Coauthorship: Does it Matter?" *Canadian Association of Radiologists Journal* 60 (5): 231–6. https://doi.org/10.1016/j.carj.2009.09.001.
Okike, K., M. S. Kocher, C. T. Mehlman, and M. Bhandari. 2008. "Industry-sponsored Research." *Injury* 39 (6): 666–80. https://doi.org/10.1016/j.injury.2008.02.013.
Olesen, A., L. Amin, and Z. Mahadi. 2018. "Unethical Authorship Practices: A Qualitative Study in Malaysian Higher Education Institutions." *Developing World Bioethics* 18 (3): 271–8. https://doi.org/10.1111/dewb.12200.
Osunsan, O. K., A. T. Ijjo, J. F. Mugisha, P. Samuel, and M. Muhwezi. 2022. "'Publish or Perish': A Systematic Review CJSSM." *Journal of Social Sciences and Management*.
Patel, V. M., H. Ashrafian, K. Ahmed, S. Arora, S. Jiwan, J. K. Nicholson, A. Darzi, and T. Athanasiou. 2011. "How has Healthcare Research Performance Been Assessed? A Systematic Review." *Journal of the Royal Society of Medicine* 104 (6): 251–61. https://doi.org/10.1258/jrsm.2011.110005.
Pruschak, G., and C. Hopp. 2022. "And the Credit Goes to … - Ghost and Honorary Authorship Among Social Scientists." *PLoS One* 17 (5): e0267312. https://doi.org/10.1371/journal.pone.0267312.
Rennie, D., V. Yank, and L. Emanuel. 1997. "When Authorship Fails: A Proposal to Make Contributors Accountable." *Jama* 278 (7): 579–85. https://doi.org/10.1001/jama.1997.03550070071041.
Resnik, D. B. 1997. "A Proposal for a New System of Credit Allocation in Science." *Science and Engineering Ethics* 3 (3): 237–43. https://doi.org/10.1007/s11948-997-0023-5.
Resnik, D. B., A. M. Tyler, J. R. Black, and G. Kissling. 2016. "Authorship Policies of Scientific Journals: Table 1." *Journal of Medical Ethics* 42 (3): 199–202. https://doi.org/10.1136/medethics-2015-103171.
Ross, J. S., K. P. Hill, D. S. Egilman, and H. M. Krumholz. 2008. "Guest Authorship and Ghostwriting in Publications Related to Rofecoxib: A Case Study of Industry Documents from Rofecoxib Litigation." *Jama* 299 (15): 1800–12. https://doi.org/10.1001/jama.299.15.1800.

Sara, S., M. Ilaria, L. Elizabeth, M. Eikermann, S. Elke, and K. Tobias. 2020. "Awareness, Usage and Perceptions of Authorship Guidelines: An International Survey of Biomedical Authors." *BMJ Open* 10 (9): e036899. https://doi.org/10.1136/bmjopen-2020-036899.

Schmidt, R. H. 1987. "A Worksheet for Authorship of Scientific Articles." *The Bulletin of the Ecological Society of America* 68 (1): 8–10. https://doi.org/10.2307/20166549.

Shaw, D., and B. Elger. 2017. "The Ghost Collaborator." *Accountability in Research* 24 (1): 43–51. https://doi.org/10.1080/08989621.2016.1207535.

Sheskin, T. J. 2006. "An Analytic Hierarchy Process Model to Apportion Co-Author Responsibility." *Science and Engineering Ethics* 12 (3): 555–65. https://doi.org/10.1007/s11948-006-0053-4.

Siegel, D. S., D. A. Waldman, L. E. Atwater, and A. N. Link. 2004. "Toward a Model of the Effective Transfer of Scientific Knowledge from Academicians to Practitioners: Qualitative Evidence from the Commercialization of University Technologies." *Journal of Engineering and Technology Management* 21 (1-2): 115–42. https://doi.org/10.1016/j.jengtecman.2003.12.006.

Slone, R. M. 1996. "Coauthors' Contributions to Major Papers Published in the AJR: Frequency of Undeserved Coauthorship." *American Journal of Roentgenology* 167 (3): 571–9. https://doi.org/10.2214/ajr.167.3.8751654.

Smith, J. 1994. "Gift Authorship: A Poisoned Chalice?" *BMJ* 309 (6967): 1456–57. https://doi.org/10.1136/bmj.309.6967.1456.

Steen, R. G. 2011. "Retractions in the Scientific Literature: Is the Incidence of Research Fraud Increasing?" *Journal of Medical Ethics* 37 (4): 249–53. https://doi.org/10.1136/jme.2010.040923.

Strange, K. 2008. "Authorship: Why not Just Toss a Coin?" *American Journal of Physiology-Cell Physiology* 295 (3): C567–75. https://doi.org/10.1152/ajpcell.00208.2008.

Strayhorn, T. L. 2010. "When Race and Gender Collide: Social and Cultural Capital's Influence on the Academic Achievement of African American and Latino Males." *The Review of Higher Education* 33 (3): 307–32. https://doi.org/10.1353/rhe.0.0147.

Teixeira da Silva, J. A. 2021. "Multiple Co-First Authors, Co-Corresponding Authors and Co-Supervisors: A Synthesis of Shared Authorship Credit." *Online Information Review* 45 (6): 1116–30. https://doi.org/10.1108/OIR-06-2020-0219.

Teixeira da Silva, J. A. 2022. "A Synthesis of the Formats for Correcting Erroneous and Fraudulent Academic Literature, and Associated Challenges." *Journal for General Philosophy of Science* 53 (4): 583–99. https://doi.org/10.1007/s10838-022-09607-4.

Teixeira da Silva, J. A., and A. Al-Khatib. 2021. "Ending the Retraction Stigma: Encouraging the Reporting of Errors in the Biomedical Record." *Research Ethics* 17 (2): 251–59. https://doi.org/10.1177/1747016118802970.

Teixeira da Silva, J. A., and J. Dobránszki. 2016a. "How Authorship is Defined by Multiple Publishing Organizations and STM Publishers." *Accountability in Research* 23 (2): 97–122. https://doi.org/10.1080/08989621.2015.1047927.

Teixeira da Silva, J. A., and J. Dobránszki. 2016b. "Multiple Authorship in Scientific Manuscripts: Ethical Challenges, Ghost and Guest/Gift Authorship, and the Cultural/Disciplinary Perspective." *Science and Engineering Ethics* 22:1457–72. https://doi.org/10.1007/s11948-015-9716-3.

Toutkoushian, R. K. 1999. "The Status of Academic Women in the 1990s No Longer Outsiders, but not Yet Equals." *The Quarterly Review of Economics and Finance* 39 (5): 679–98. https://doi.org/10.1016/S1062-9769(99)00023-X.

Tscharntke, T., M. E. Hochberg, T. A. Rand, V. H. Resh, and J. Krauss. 2007. "Author Sequence and Credit for Contributions in Multiauthored Publications." *PLoS Biology* 5 (1): e18. https://doi.org/10.1371/journal.pbio.0050018.

Verhagen, J. V., K. J. Wallace, S. C. Collins, and T. R. Scott. 2003. "QUAD System Offers Fair Shares to All Authors." *Nature* 426 (6967): 602. https://doi.org/10.1038/426602a.

Waleed, A.-H., H. Hani, A.-B. Mahmoud, and S. Adnan. 2014. "Honorary Authorship in Biomedical Journals: How Common is it and Why Does it Exist?" *Journal of Medical Ethics* 40 (5): 346. https://doi.org/10.1136/medethics-2012-101311.

Waltman, L., and N. J. van Eck. 2012. "A new Methodology for Constructing a Publication-Level Classification System of Science." *Journal of the American Society for Information Science and Technology* 63 (12): 2378–92. https://doi.org/10.1002/asi.22748.

Wang, X., N. Gao, H. Chen, and W. Wang. 2023. "Review of Retracted Papers in the Field of Neurology." *European Journal of Neurology* 30 (12): 3896–903. https://doi.org/10.1111/ene.15960.

Wang, Y., X. Li, H. Cheng, and L. Zhang. 2024. "Understanding Responses to Managerialism: Faceculture and University Faculty Working Under the Shadow of 'Publish or Perish'." *Culture and Organization* 30 (4): 405–24. https://doi.org/10.1080/14759551.2023.2283072.

Wang, F., L. Tang, L. Bo, J. Li, and X. Deng. 2012. "Equal Contributions and Credit Given to Authors in Critical Care Medicine Journals During a 10-yr Period*." *Critical Care Medicine* 40 (3). https://journals.lww.com/ccmjournal/fulltext/2012/03000/equal_contributions_and_credit_given_to_authors_in.35.aspx.

Warrender, J. M. 2016. "A Simple Framework for Evaluating Authorial Contributions for Scientific Publications." *Science and Engineering Ethics* 22 (5): 1419–30. https://doi.org/10.1007/s11948-015-9719-0.

Washington University in St Louis. 2009. *Policy for Authorship on Scientific and Scholarly Publications Policy*. Washington University in St Louis, May 3, 2017. https://research.wustl.edu/policy-authorship-scientific-scholarly-publications/.

Whetstone, D., and H. Moulaison-Sandy. 2020. "Quantifying Authorship: A Comparison of Authorship Rubrics from Five Disciplines." *Proceedings of the Association for Information Science and Technology* 57 (1): e277. https://doi.org/10.1002/pra2.277.

Winkler, J. A. 2000. "Faculty Reappointment, Tenure, and Promotion: Barriers for Women." *The Professional Geographer* 52 (4): 737–50.

Wislar, J. S., A. Flanagin, P. B. Fontanarosa, and C. D. DeAngelis. 2011. "Honorary and Ghost Authorship in High Impact Biomedical Journals: A Cross Sectional Survey." *BMJ* 343 (oct25 1): d6128. https://doi.org/10.1136/bmj.d6128.

Xu, S., and G. Hu. 2018. "Retraction Notices: Who Authored Them?" *Publications* 6 (1): 2. https://www.mdpi.com/2304-6775/6/1/2

Xu, S., and G. Hu. 2022. "A Cross-Disciplinary and Severity-Based Study of Author-Related Reasons for Retraction." *Accountability in Research* 29 (8): 512–36. https://doi.org/10.1080/08989621.2021.1952870.

Yank, V., and D. Rennie. 1999. "Disclosure of Researcher Contributions: A Study of Original Research Articles in The Lancet." *Annals of Internal Medicine* 130 (8): 661–70. https://doi.org/10.7326/0003-4819-130-8-199904200-00013.

Yousefi, A., M. Hemmat, A. Gilvari, and T. Shahmirzadi. 2012. "Citation Analysis and Co-Authorship of Iranian Researchers in the Field of Immunology in ISI Web of Science: A Brief Report." *Tehran University Medical Journal* 70 (3): 188–193.

Yukawa, Y., C. Kitanaka, and M. Yokoyama. 2014. "Authorship Practices in Multi-Authored Papers in the Natural Sciences at Japanese Universities." *International Journal of Japanese Sociology* 23 (1): 80–91. https://doi.org/10.1111/ijjs.12016.

Zuo, Z., and K. Zhao. 2018. "The More Multidisciplinary the Better? – The Prevalence and Interdisciplinarity of Research Collaborations in Multidisciplinary Institutions." *Journal of Informetrics* 12 (3): 736–56. https://doi.org/10.1016/j.joi.2018.06.006.