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Defining Responsible and Equitable Authorship by a Principle-based Approach

LEAGUE OF EUROPEAN RESEARCH UNIVERSITIES

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Contents

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About LERU

LERU was formed in 2002 as an association of research-intensive universities sharing the values of high-quality teaching in an environment of internationally competitive research. The League is committed to: education through awareness of the frontiers of human understanding; the creation of new knowledge through basic research, which is the ultimate source of innovation in society; the promotion of research across a broad front, which creates a unique capacity to reconfigure activities in response to new opportunities and problems. The purpose of the League is to advocate these values, to influence policy in Europe and to develop best practice through mutual exchange of experience.

Executive Summary

Authorship is important for career progression but it also implies responsibility for the integrity of work undertaken. There are various guidelines for authorship, but with no clear definition and with tacitly agreed standards which vary between disciplines, it can be a matter of interpretation and negotiation who will be listed as an author. It is often not clear what contribution each person has made to the specific project and this can lead to authorship disputes.

Some recent studies make clear that responsible and equitable authorship is still far from being the norm. Well known authorship guidelines and criteria do exist, but do not seem to be widely used. While there can never be a fail-safe mechanism to prevent authorship malpractice, universities should always strive to raise awareness of what responsible authorship is amongst their researchers, encouraging an open dialogue on authorship early on in the research process and creating an environment where these good practices can flourish.

In this LERU paper, we aim to develop a common understanding of what responsible and equitable authorship is, by using the four principles of the ALLEA Code as a basis. These principles are core values that one can refer to at any time when dealing with any aspect of research, including authorship. Depending on the stakeholder, their meaning in the context of attributing responsible and equitable authorship might slightly differ and have different weightings. To show how this could work in practice, based on the experience gained within the LERU universities, we formulated recommendations for some of the different stakeholders, such as a) researchers, b) universities and c) journals. We are aware that there are also other important stakeholders (such as funding agencies) but we did not address them in this paper.

By raising awareness of the elements that form the basis for responsible and equitable authorship, through the shared European principles of research integrity, we hope to contribute further to the dialogue and reflection on what responsible and equitable authorship is.

1. Introduction

Research is becoming increasingly collaborative, global and interdisciplinary. In this evolving context, it is of utmost importance to make clear arrangements within the team about the publication process, taking into account disciplinary differences, and to give appropriate credit to all the team members where credit is due, including to those who are affiliated with low- and middle-income countries, early career researchers, or are female. Attributing authorship in a responsible and equitable way is important for individual researchers since the publication output is often still a key indicator in the recognition and reward system of researchers. It is also important during the peer review process (in case of a single blind review) and for the readers to know who was involved[1] in the published work together with any competing interests of the authors. There is, however, no global standardised definition on what constitutes appropriate authorship.

There is no global unified view on authorship criteria

When reflecting on authorship criteria, there are some international reference documents which are often perceived as important anchors, and which include some influential principles. First, the **Committee on Publication Ethics (COPE)**, which counts over 12,000 journals worldwide and from all research fields amongst its members, acknowledges that *"the minimum requirements for authorship, common to all definitions, are 1) substantial contribution to the work and 2) accountability for the work that was done and its presentation in a publication. It is important that authors know, understand, and adhere to the criteria for authorship within their respective disciplines."* (COPE Discussion document, 2019)[2].

Second, the **ICMJE guidelines** (updated May 2023, produced by the International Committee of Medical Journal Editors[3], originally known as the Vancouver Group), are widely accepted and set a high standard in the biomedical sciences and beyond. These guidelines mention four criteria which qualify authorship:

1. *Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND*
2. *Drafting the work or reviewing it critically for important intellectual content; AND*
3. *Final approval of the version to be published; AND*
4. *Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. In addition to being accountable for the parts of the work done, an author should be able to identify which co-authors are responsible for specific other parts of the work. In addition, authors should have confidence in the integrity of the contributions of their co-authors.*

Many publishers and journals have now adopted recommendations from McNutt et al (2018)[4], which expand on the ICMJE's definition of 'substantial contribution' and specifically mention creation of new software, but on the other hand no longer consider the actual drafting of the manuscript as a requirement for all the potential authors.

Last but not least, there is the **European Code of Conduct** (ALLEA[5]) which seeks to provide a unified understanding of research integrity across Europe.

Regarding good authorship practices, the 2023 ALLEA Code states (amongst others) that *"Authors formally agree on the sequence of authorship, acknowledging that authorship itself is based on: (1) a significant contribution to the design of the research, relevant data collection, its analysis, and/or interpretation; (2) drafting and/or critical reviewing the publication; (3) approval of the final publication; and (4) agreeing to be responsible for the content of the publication, unless specified otherwise in the publication."*

Challenges to agreeing one definition

Common denominators in the above-mentioned documents are the requirement of a *significant contribution to the work* and the *accountability for the work*, with the proviso that these elements are sometimes the basis for some discussion. One can have a different view on what counts as 'significant' or 'substantial' scholarly contributions to the research output and the meaning of being 'accountable' for the work and its presentation.

There are also some differences in the way authorship criteria are defined. An important one is whether the different criteria (contribution to the research project versus the contribution to the drafting or reviewing process) are cumulative criteria or not. However, we should note here that the authorship criteria in the recently revised ALLEA code (2023) are now aligned with the ICMJE guidelines.

Some additional challenges to agreeing one definition for authorship include:

- the existence of discipline-specific guidelines (the accepted norms vary across disciplines) which should be agreed upon in multidisciplinary collaborations;
- the existence and variation in journal requirements;
- large collaborations;
- differences in local (national or institutional) settings.

For example, the rise of multi-institutional and multidisciplinary projects creates large research groups that need to deal with authorship, often producing articles with 100s or even 1000s of authors – often referred to as 'hyperauthorship'. With so many contributors, it becomes an issue how to deal with 'accountability' and whether 'authorship' is a 'correct' or a 'fair' way to acknowledge the contributions in such a setting[6].

Authorship problems are widespread and manifold

Despite the existence of various guidelines on authorship, several empirical studies have shown that granting authorship does not always occur in a responsible and fair manner and unacceptable authorship practices persist.

Non-equitable authorship practices are still rife, e.g. the Cape Town Statement[7] states that *"it is common knowledge that African collaborators are often not acknowledged fairly"*. Naidoo et al (2021)[8] analysed African authorship on African-related papers during the COVID19 pandemic and found that *"one in five African COVID19 papers had no African authors and 66% of authors on these papers in 10 top medical journals were not from Africa. While non-Africans comprise 66.1% of authorship on African papers, Africans comprise just 3.1% of authors on non-African papers."* On the one hand, these observations might be linked with the practice of excluding local expertise in the research, i.e. parachute research (which is a wider problem about who is invited into research projects). On the other hand, this might also be linked with the absence of recognition of local researchers for their participation to the research (which is the focus of this LERU paper). Likewise, it has been acknowledged that women[9, 10] and early career researchers[11, 12], can face bias in authorship attribution.

While the Cape Town Statement referred to perceptions that LMIC collaborators are often not acknowledged fairly, concerns have also been raised over the inappropriate inclusion of authors from Low- and Middle-income Countries (LMICs) as a way for authors from higher income countries to get the full article processing charges (APCs) waived[13].

While some do not get the credit they deserve, unjustified credit is just as common. A Wellcome Trust survey[14] in 2020 found that *"40% of all respondents said that they had experienced issues with others taking credit for their work"*. PhD students can feel coerced into giving gift authorship on papers by people in a position of power over them. A study published in 2023 showed that 3 out of 10 of the participating European PhD students reported they had granted at least one guest authorship to "a person in power"/senior researcher and that half of these had done so because the person in power had told them to[15]. A recent International Research Integrity Survey (IRIS) (2023)[16] found that "*almost 70% of researchers based in Europe say that they have been involved in projects in the past three years that listed authors who did not contribute sufficiently to the work"*. Based on the experience gained within LERU universities, senior researchers have also been named in the author list of a paper without being asked.

In an interview with John Ioannidis in Stanford Medicine[17], he stated that *"it's likely that many fields have changed the bar that scientists must pass to become an author. In our survey of hyperprolific authors, most of them admitted that, in many of their papers, they did not meet the traditional Vancouver criteria[18] for authorship."* In a review article in Nature in 2018[19], he defined 'hyperprolific' authors as people who publish more than 72 papers per year between 2000 and 2016 (the equivalent of publishing a paper every 5 days).

Listing an author who does not qualify for authorship (gift or guest authorship) was perceived to be the most frequent research misbehaviour by biomedical researchers in a survey of Dutch scientists[20] in 2019. Furthermore, authorship, can be for sale[21] for those willing to pay the price[22, 23]. Not listing an author who does qualify for authorship is called ghost authorship. Ghost authorship hides contributions made to research, prevents authors from being credited for their work, as well as preventing transparency of those who significantly contributed to the work. This is problematic, for instance when industry has had a significant role in developing the paper and this is not acknowledged[24] as it can bias the results of the paper. Ghost, gift and guest authorship are unacceptable research practices.

More recently, there have been cases observed within LERU universities of designated authors who contributed to a paper and try to "negotiate" the terms of authorship in an unfair manner. For instance, coercion is applied to obtain advantages, such as being first author, by threatening that agreement for publishing the article will be denied unless the request is agreed to. In doing this, one person can hinder or obstruct the publication of research results and the research progress of a whole group.

In a 2020 Norwegian study[25] of PhD students in health sciences at three universities in Scandinavia (Stockholm, Oslo, Odense), about 36% to 46% indicate that authorship misconduct is a common issue in their research area. "*At all three universities, the prevalence of authorship misconduct was perceived as much higher than other types of misconduct, the risk of detection of authorship misconduct as lower, and the consequences of being detected in having committed authorship misconduct much less severe."*

These recent studies make clear that responsible and equitable authorship is still far from being the norm. Well-known authorship guidelines and criteria do exist but do not seem to be so widely used[26]. While there can never be a fail-safe mechanism to prevent authorship malpractice, universities should always strive to raise awareness of what responsible authorship is amongst their researchers, encouraging an open dialogue on authorship early on in the research process and creating an environment where these good practices can flourish.

2. Translation of the ALLEA principles into the concept of responsible and equitable authorship

There is no global unified view on defining authorship criteria, but as LERU universities we support the move towards more unification of the concept of authorship by reflecting on some common principles. The aim of this paper is to find a common language towards authorship by translating the four principles of the ALLEA Code into the concept of responsible and equitable authorship. The ALLEA Code, known as the European Code of Conduct for Research Integrity, is a pan-EU code for promoting responsible research practices in Europe and is widely used by researchers in the EU as a reference guide. The ALLEA Code sets out the four principles of research integrity that support good research practices: **reliability, honesty, respect and accountability**.

These principles are core values that one can refer to at any time when dealing with any aspect of research, including authorship. Depending on the stakeholder, their meaning in the context of attributing responsible authorship might slightly differ and have different weightings. Dictionaries and the internet offer many definitions for each of the principles, and while drafting this guidance, we considered the following explanations to be helpful but not exhaustive in this context:

- Reliability – "the quality of being trustworthy or of performing consistently well."[27]
- Honesty – "honesty implies a refusal to lie, steal, or deceive in any way."[28]
- Respect – "due regard for the feelings, wishes, or rights of others."[29]
- Accountability – "the fact of being responsible for what you do and able to give a satisfactory reason for it."[30]

Which definition is used and how will be always up to the individuals, but these core values can serve as a compass to guide both individuals and groups when dealing with authorship. To show how this could work in practice, we formulated recommendations for some of the different stakeholders based on the experience gained within the LERU universities. The rest of this paper outlines recommendations for a) researchers, b) universities and c) journals, regarding responsible and equitable attribution of authorship using the ALLEA principles as a basis. We are aware that there are also other important stakeholders. For example, we also expect that funding agencies take their responsibility by reviewing how their assessment systems impact authorship practices but we will not address those in this paper.

By raising awareness of the elements that form the basis for responsible and equitable authorship, through shared European principles of research integrity, we hope to further contribute to the dialogue and reflection on what responsible and equitable authorship is.

A. Recommendations for researchers

This section focuses on the meaning of the shared ALLEA principles for the attribution of authorship and acknowledgement both within and across *research teams*.

Reliability

We need to ensure the trustworthiness of the author list, author contribution statement and acknowledgment section. This applies to all research outputs, including, for example, preprint and poster presentations. Researchers are recommended to:

- *agree with the team/collaborators on the criteria for authorship* – ideally at the outset of the specific research collaboration - and to apply them to all of the contributions, thereby *taking into account* the accepted authorship guidelines relevant to the disciplines, the institutions and the journal. If there is a conflict between different accepted authorship guidelines, there should be an honest and open discussion amongst the team on how to best approach this issue. It is important to have these conversations in a safe and inclusive environment where all collaborators feel comfortable to participate in the discussion;
- use standardised categories of contributor roles (cf. Contributor Roles Taxonomy (CRediT)[31]) to the widest extent possible in order to define the contributions of the authors in a consistent way in the author contribution statement;
- ensure that all authors have an opportunity to *review and approve* the final manuscript, including the author list and author contribution statement;
- inform or seek consent (as required) from the contributors who are named in an acknowledgment section.

Honesty

The principle of honesty plays a crucial role when reflecting on responsible authorship practices within or across research teams.

Researchers should be honest in granting and communicating authorship, author order, affiliation, acknowledgment and any revisions thereof. This can be facilitated through the following actions:

- *At an early stage* of the research, have an *open, honest and transparent discussion* within the research team about the expected roles and how this will be linked to authorship (including the authorship order) and other forms of acknowledgment, taking into account accepted authorship guidelines. Continue this discussion throughout the lifetime of a research project;
- Where appropriate, keep written records of these decisions (cf. authorship record template[32]). These should be revised when roles or contributions change, for example as researchers join or leave a research project or team. Any such revisions should be communicated to all parties involved with a request for approval;
- Agree from the start upon an approach for *non-responsive co-authors*, for instance by setting a clear, but generous timeframe within which a co-author should react;
- Remember that it is not allowed to *change the agreed order of authorship* when communicating about the research output. *This includes your own CV and* even when mentioned second in a shared first author publication;
- Include an *honest author contribution statement* (cf. CRediT roles[33]) in your research outputs, allowing others to see who did what and delimiting responsibilities;
- *Only attribute authorship to* those individuals who have contributed in a *significant and/or substantial way to its intellectual content*. What counts as 'significant' or 'substantial' scholarly contributions to the research output will be dependent on the traditions and norms of the research discipline and must be evaluated on a case-by-case basis. Remember, all contributions should be acknowledged, but not all contributions will be sufficiently significant to qualify for authorship;
- Be *honest* about your author affiliations by *correctly citing* the institution or institutions where the research in question was conducted or who takes the responsibility for the research. In case a researcher has left an institution, and has not significantly contributed to the research while at the new institution, the latter should not be used as the affiliation. However, the current address can be stated in a footnote.

Respect

Care and respect for others, the *team* and *other contributors*, should be at the centre of authorship considerations.

Researchers are recommended to:

- Show respect for *students* and *early-stage researchers*. *"Supervisors of undergraduate and postgraduate students should firmly protect the students' rights in terms of publication and authorship"*[34] and ensure that their contributions are appropriately recognised;
- Show respect for research collaborators from *Low-and Middle-Income Countrie*s (LMICs)[35, 36];
- Show respect for core *facility staff*[37] and *technical staff* who contributed to the research output by providing technological services and expertise. It is important to explore their contributions (routine versus intellectual contributions) in relation to being named in the author list or the contribution section. If their contribution goes beyond standard procedures (such as *"development or adaptation of protocols to suit samples or materials, (re)designing experiments, extensive data analysis and interpretation"*[38]), they merit co-authorship;
- Show respect to the *owners of datasets, patient case studies*, etc. that you are accessing or being provided with for your research, by considering at the start the involvement the data owners will have in the research. Acknowledging the origins of the datasets in papers is important, and some may be appropriate for authorship too;
- Show respect for d*isciplinary differences* by considering variations in practices when discussing *order of authors*. In the biomedical field the first and the last authors are usually the persons who contributed most, while in other disciplines the contribution level decreases with the position of the author. There are also disciplines, such as mathematics, which use alphabetical listings;
- Show respect for the *research team members* by maintaining a constructive attitude and be open to dialogue so that a manuscript can be completed and published within a reasonable time;
- Show respect for the *research record* by not unreasonably preventing otherwise accurate outputs from being published due to authorship disputes.

Accountability

With authorship comes *responsibility*. While different types of research roles and levels of seniority carry specific (accompanying) responsibilities, all researchers are accountable for:

- Their own actions or inactions; so that if they see something that worries them or they are not sure about, they should be able to raise it;
- The accuracy and integrity of their own contributions to the published work;

- The storage of their original research data on which the publication is based in a findable and accessible way[39] and in accordance with the institutional research data management policy and good practices in the discipline;
- Being able to identify which co-authors are responsible for other specific parts of the work;
- Having justified confidence in the work of collaborators (some level of trust is needed in collaborative research, in particular when it is spanning different disciplines and large physical distances);
- Ensuring that all questions related to the research output are investigated and resolved with due care.

In the assessment of the responsibility of each author, it is recommended to look at the *"respective roles in research, taking into account the author's discipline and research expertise, seniority, supervisory role or other relevant factors"*[40].

The responsibilities of authors continue post-publication. Where authors identify or are made aware of any errors or inconsistencies in their research outputs, they have a responsibility to review these honestly and to seek to correct these in the published work. The corresponding author (or most senior author) often takes the lead in this correction process.

B. Recommendations for universities

Institutions are responsible for cultivating a culture of research integrity among their research community. Supporting researchers to have responsible and equitable authorship practices is a core part of this wider responsibility. Institutions should take accountability for practice under their remit by reviewing how institutional policies and systems impact authorship practices and by having appropriate dispute resolution mechanisms in place.

A multi-faceted approach is needed to stimulate responsible and equitable authorship, starting with training and awareness raising amongst researchers, together with journals, but also by recognising that authorship often plays a role in assessment frameworks for researchers.

Reliability and honesty

Institutions should take steps to ensure that their research community is fully aware of its obligations as regards reliable and honest authorship practice and has the skills and expertise necessary to deliver on them. Institutions are recommended to:

- Have a clear policy or position statement on institutional expectations as regards authorship. Care should be taken to ensure either that the institutional guidance is applicable to all disciplines or that discipline specific statements are provided.

  Such a document does not necessarily need to be comprehensive but should encourage and/or direct researchers to have open discussions with each other about authorship, building on a shared understanding of best practice;
- Educate and provide training for all career stages on best practice in authorship. This may be stand-alone training or form part of a wider research integrity training package. It is recommended that training is hands-on and includes exploration of case studies of challenges that can emerge relating to authorship in the publication process. Universities should start early with education and training on authorship since correction of views at later stages is not always easy;
- Provide advice and support for researchers, particularly early career researchers, with questions or concerns regarding authorship. Advice should be available from sources outside the immediate research group;
- Develop, or utilise existing, practical tools through which authorship can be discussed, and publicise these within the institution;[41]
- Develop an institutional policy or approach towards author affiliation, making it clear when and how authors should indicate their affiliation to the institution and when the institution takes responsibility for that publication. Consider making the policy public.

Respect

Appropriately acknowledging the work of others is a fundamental component of a respectful research culture. Authorship issues also often emerge as part, or a result, of wider issues within the research culture, particularly poor interpersonal relations or unhealthy power dynamics within research groups. Institutions should also ensure that those who promote good authorship practices, even when it is difficult to do so, are supported and respected. Institutions are recommended to:

- Cultivate good authorship practice with wider institutional research culture strategies and activities;
- Ensure that those leading efforts to improve research culture are aware of the importance of respectful authorship to maintaining a positive local culture;
- Consider ways in which research culture or integrity initiatives could be adapted to include authorship and responsible authorship practices; for example, including authorship in research culture and/or integrity climate surveys to capture institutional understandings of authorship and foster dialogue on responsible practice across the organisation;
- Where poor practice is identified, provide support to research groups to improve their local authorship culture;

- Take active steps, including high-level statements and integration into training and guidance to destigmatise the correction of authorship where necessary and take active steps to support and stand up for authors who do so.

Accountability

As employers of researchers, institutions must both take accountability for their own role in facilitating a culture of good authorship and ensure that those who do not uphold best practice are held accountable. Institutions are recommended to:

- Have appropriate processes for handling authorship disputes. It is widely accepted (see for example the ICMJE authorship guidelines[42] and the Committee on Publication Ethics authorship guidelines[43]) that institutions should handle disputes between authors relating to authorship. There are multiple approaches that could be followed within institutions if agreement cannot be reached through direct dialogue between the involved parties, these are likely to take one of two forms:
  - An informal route that involves local mediation with the help of departmental colleagues, an ombudsman, integrity adviser or third-party mediator. Experience within the LERU universities shows that personal skills or 'soft skills' such as conflict resolution or managing difficult conversations, are paramount to reach an agreement, or
  - A formal route that involves an investigation according to a formal policy. Such an approach would normally only be used where it is not possible to resolve the matter informally and is more likely to apply post-publication.
- Consider, and take steps to address, institutional policies that may be encouraging poor authorship practice. In particular, institutions should consider the role of their assessment frameworks for research and/or researchers in the problem of irresponsible authorship. Assessment processes that focus solely on the number of publications and in which journals they are published may encourage researchers to use poor practices to 'game the system'. Evaluation systems that place less emphasis on 'authorship' may lead to better authorship practice in the long run. To address this, institutions should consider what they really value and make changes that support best practice. In view of our call to stimulate responsible authorship, this means for universities to put into their assessment framework:
  - Consideration of established frameworks for improving assessment, for example the San Francisco Declaration on Research Assessment (DORA)[44] and the Coalition for Advancing Research Assessment[45] and how these can be implemented in the institution;
  - A greater focus on contribution to research outputs than solely on authorship.

    In particular, an institutional shift to requiring applicants to describe their main scientific achievements and their contributions to a small number of their most important publications may help to move the focus away from seeking large numbers of publications. Institutions can also draw on developments in research publishing, such as contribution lists, authorship contribution statements and the contributor role's taxonomy (CRediT[46]), to build assessment processes that take a more holistic approach to a researcher's contribution to a project. This can also be achieved by including substantive questions about co-authored publications as part of the promotion process. This may all help in moving *"from a performance approach towards a new approach focusing on contribution"* in the assessment of researchers (LERU position paper on research assessment, 2022[47]) and might counteract gift authorship. Potential future developments, such as the recommendation by McNutt al al (2018)[48] to embed these CRediT roles within author metadata in a machine-readable format allowing automatic interoperability of the CRediT roles into institutional publication repositories, may assist this process;
  - More emphasis on the role of researchers as role models for university values, including *"collegiality, mutual respect and research integrity"*[49]. A potential approach to this is to incorporate into assessment processes a structured narrative or bio sketch in which researchers can include less visible contributions, such steps taken to build local cultures of best practice in authorship and research integrity.

C. Recommendations for journals

Research publications in academic journals are still the main medium via which research outputs are shared with other researchers and the public. The publishing landscape is complex, journals can be run independently, by societies, professional associations, or publishing houses. While management arrangements might differ, the editors maintain editorial independence and editorial decisions must be separate from the commercial interests. Editors are responsible for maintaining the integrity of the scientific record. This includes setting editorial polices. The Committee on Publication Ethics (COPE) has emerged as a source of consistent guidance for the policies and practices journals and publishers need to reach the highest standards in publication ethics and support research integrity also regarding responsible authorship practices. They assist in bringing consistency between editorial policies where possible through the organisation of forums, workshops and meetings with editors.

While journals and their owners must have clear authorship polices, which set out applicable authorship criteria and how authorship change requests will be managed, we recognise that it is not for the editors to resolve authorship disputes, as they would not be able to access all pertinent data and information to make such decisions. As a result, the consensus in the publishing world is that such issues need to be resolved by the authors themselves or by their institutions. COPE provides specific guidance and flow charts on how the editors can deal with authorship issues[50].

Researchers are guided by the expectations and requirements set within the editorial policies, therefore, journal editors need to respond to new challenges, as the researchers will often rely on them to do so and follow their requirements.

The publication landscape is not only complex but also evolving. Alternative publishing models such as e-Life[51] are reforming scientific publishing (including how research is peer reviewed in an open and transparent way) and are interesting to explore further. The recommendations below are also useful for these new alternative publishing platforms.

We believe the principles of integrity can be useful for journals, their editors and also for alternative publishing models when setting authorship polices or dealing with authorship issues. Below we offer some specific suggestions and recommendations:

Reliability

The researchers need consistent and clear guidance on authorship related requirements. Journals are recommended to:

- Set clear authorship criteria and how other types of contributions need to be acknowledged;
- Have clear editorial polices outlining how they will deal with authorship change requests or authorship disputes e.g., using declaration of authorship statement (BIOMED), referring to COPE guidance, etc.;
- Stipulate the use of personal identifiers for all authors, like ORCID, which will also support better accountability. This is already required by some journals[52] (e.g. PLOS journals); Clearly include these personal identifiers in the metadata of the articles to facilitate author identification when the metadata are sent to bibliographic databases such as Web of Science or Scopus, and when the DOIs are registered, for example, via CrossRef;
- Be alert to warning signs of inappropriate authorship, which can be included in training and information for editors and reviewers. COPE offer guidance on this[53];
- Be aware of and actively participate in discussions on evolving challenges around authorship and adapt processes and policies as necessary.

Honesty

Journals can help champion honesty and support full acknowledgment of contributions. Journals are recommended to:

- Stipulate the use of author contribution statements like e.g., CRediT taxonomy, and include the CRediT roles in a machine readable format;
- Explore and allow use of visual tools for indicating contributions[54];
- Explore the feasibility of making transparent who is responsible for specific figures, e.g. revealing the identity of the author of the figure in the figure legends[55]. This would make it easier for research integrity panels at universities to resolve authorship disputes but also potential misconduct allegations on image manipulations;
- Consider publishing an expression of concern alerting the readers to the authorship concerns, if a decision cannot be made relating to a post publication authorship dispute.

Respect

Journals are recommended to:

- Promote equitable authorship in research publications from HIC-LMIC partnerships by asking the authors to submit an author reflexivity statement “to describe the ways in which equity has been promoted in the partnership that produced the research” (cf. consensus statement[56] on measures to promote equitable authorship).

Accountability

Journals are recommended to:

- Have a procedure in place to inform all co-authors of their inclusion in the author list e.g. via statement, automatic email confirmation to co-authors, signature, etc.;
- Outline what is expected of corresponding author(s) as this role involves considerable responsibility;
- Have unambiguous guidelines about author affiliation disclosures. Affiliations link the particular individuals and their work with institutions which can have positive impact on them, e.g. for their ranking, but also implies their accountability for the work[57];
- Take the necessary steps to correct a scientific record, via erratum, corrigendum, or in extreme cases retraction or an expression of concern[58], as appropriate, and do so swiftly after gaining knowledge of an issue.

3. Conclusion and some future perspectives

In the sections above, we have sketched out, using the ALLEA principles as a starting point, what authorship is or should be, what principles form the basis of appropriate authorship, and what are the threats to research integrity with regard to authorship. However, more discussion and guidance is needed on what counts as a significant or substantial contribution. Since this is dependent on the traditions and norms of the research discipline, the next step could be to consider, by discipline, what is a significant contribution. This could have two objectives: 1) help train researchers with regard to the differences per discipline, and 2) avoid unfair competition between disciplines.

Scientific work needs to be attributable to individuals, who receive credit for their work and are accountable for it. Most of the problems associated with authorship listed above arise from its link to credit. Universities and granting agencies often use authorship indices as markers for scientific excellence, and therefore being listed as an author on publications improves the likelihood of promotion in the academic ranks and receiving financial support for future scientific work (and more publications). This leads to a vicious circle of perverse incentives: firstly, because of the importance of publications to an academic career, individuals may strive to be listed as authors even when their contribution is minimal, which, secondly, will make the indices meaningless – which follows Goodhart's Law, which is often paraphrased as *"when a measure becomes a target, it ceases to be a good measure"*. This has led to the suggestion to revise those indices, e.g., to normalise the citation index for the number of authors. However, if we are not able to measure the contribution to scientific knowledge of a particular piece of scientific work – for which all indices are proxies –, such endeavours are doomed to take us further in the vicious circle of perverse incentives and will lead to a further decrease in clarity about authorship rather than a clear understanding of what it means that we strive for.

A first, logical and seemingly simple step would then be to curb the use of indices based on authorship for awarding grants or academic promotion. This is being tried in the Swiss National Science Foundation[59] and the Netherlands[60] currently, where curricula vitae that are part of grant applications are required to be a qualitative narrative, with less emphasis on quantitative items. Similarly, universities in the Netherlands are employing a promotion system called "Erkennen en Waarderen" (Recognition and Rewards) where firstly scientific achievements need to be described, including what contributions people made, and secondly other academic qualities (e.g., teaching, supporting, leading) are also considered, thereby diluting the importance of the number of authorships and citations. A similar approach is in progress in several LERU universities.

While this will not solve everything because there are more incentives than the ones listed here, such as narcissistic satisfaction or peer pressure, it will be an enormous first step towards a future where the number of publications and authorship are no longer viewed as the primary aim of the scientific enterprise. This is also in line with the vision explained in a recent LERU position paper[61] about a new framework for the assessment of researchers and in the 'Coalition for Advancing Research Assessment (CoARA)' initiative[62], of which some LERU universities are part of.

There are many other challenges that need resolution. Research used to be done only by the academics themselves, the experts, but this has been changing as it is more and more recognised that it is important and useful to give voice to non-academic collaborators and stakeholders when designing research. Co-creation or participatory research has become increasing used in many disciplines, particularly in the medical and social sciences domains. Currently, such contributions are mostly recognised via acknowledgment and rarely in a form of authorship. Raising questions whether such practice is 'fair' again comes back to the definition of 'authorship' and links with the bigger issues of 'equitable authorship'. Sarna-Wojcicki et al., 2017[63] note that this can be an important component of 'epistemic justice'. In order to fulfil the requirements the 'respect' principle of research integrity puts on the researchers, more transparent and open conversations need to happen with all the stakeholders.

Other known challenges stem from disciplinary differences. Whereas in single-authored works in the humanities one can still envision the author, or a small group of authors, as word smiths, who actually handle the pen or type in the words, this is difficult for publications in genomics or physics with more than 50 or 100 authors. To some extent this reflects that in the humanities the scientific idea is an intrinsic part of the words of the text themselves (strongly writing-oriented view on authorship), whereas in medical or technical reports the words guide the reader through the numerical results (more inclusive view on authorship)[64]. Although this is a general thought that cannot be applied indiscriminately, it shows that for some publications, specifically those with many authors, the term 'author' has a different meaning to that in oligo-authored publications: the many researchers who are listed may be considered contributors rather than authors.

Regardless of who the collaborators are or how many of them there are what is useful, is to explicitly describe what the contribution was of each individual.

Many journals already ask authors to indicate their contribution, but this is still quite loosely defined, with some using narrative descriptions, others using the CRediT taxonomy with a relatively limited number of categories. One approach would be to go much further than the use of predefined categories, to the extent that the authors each add a paragraph on their actual contribution to a specific article. It is of note that some journals, particularly in the biomedical field, distinguish between 'authors' and 'contributors', which, without clear definitions, further muddies the issue rather than bringing more clarity between various roles.

This listing of individual contributions could go further still, and even so far that the role of authorship completely disappears; there are only contributors, and each contribution is clearly described. This would resemble the credits shown at the end of a movie, where every function is listed ("movie-style credits"[65, 66]). Although this concept might feel to be too far away from realisation to be practical at present, the advantage of this system is that the cut-off for authorship versus contribution, or versus acknowledgement, disappears: every contribution is described in detail and credited, also the ones that were of a supportive or analytical nature that would normally not qualify for authorship. This, in itself has, the advantage of giving credit to those individuals, too.

These perspectives all deal with credit, but what about accountability? Accountability is a crucial aspect of authorship; if we are willing to take credit, we must be willing to take the responsibility too. This has recently come to the foreground with the advance of technology, particularly release of the Artificial Intelligence (AI) writing tools like ChatGPT. Although the possibility has been raised that such a text could have the AI technology as an author, several journals have now taken the position that it cannot be named as an author, since the tool cannot take responsibility or be accountable[67]. Indeed, the updated ICMJE recommendations (May 2023)[68] mention that *"chatbots (such as ChatGPT) should not be listed as authors because they cannot be responsible for the accuracy, integrity, and originality of the work, and these responsibilities are required for authorship"*.

Looking at the example of listing contributions only, how could responsibility be applied when things go wrong? Again, if contributions are specified per contributor, this would help when dealing with breaches of research integrity, such as data manipulation or plagiarism. However, who will be taking the credit for the overall research? Who will be the 'lead contributor', the 'director' of the movie? This then takes us back to the difference between the 'contributor and 'author' and we are back where we started.

For now, we will have to accept that no system is perfect. We should be aware, though, of the imperfections, and the way in which these may be used. We all need to strive to be better and applying the principles of integrity will help us to be as fair as we can be and get us closer to that 'ideal' outcome for everyone.

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