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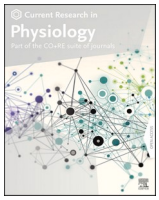

Unveiling the ethical void: Bias in reference citations and its academic ramifications

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ABSTRACT

Citation bias receives scant attention in discussions of ethics. However, inaccurate citation may lead to significant distortions in scientific understanding. Although ethnical and gender citation disparities have been proposed as critical aspects, there are other contributors to citation distortions, like region-based citation bias, that, although less recognized within the scientific community, are equally important. While the foundations of scientific citation include acknowledging pioneers, giving credit to related work, and providing background reading, other more subjective or even questionable criteria are often used when constructing a reference lists. Here, we discuss the potential causes and ethical concerns of citation bias, emphasizing the role of international- or region-based citation bias as one of the most harmful aspects of this ethical breach. We argue that the international scientific community should be aware of this problem and recognize its consequences, which include hindering the accurate dissemination of science, marginalizing underrepresented voices in academia, and impeding scientific progress. We advocate that scientists should compile their reference lists with the same seriousness and integrity they apply to all other aspects of their research.

> *"At last, once the prejudice against the modest Spanish anatomist had faded, the congratulations exploded warmly and sincerely"*. S. Ramon y Cajal. Memory of my life, 1917

When discussing ethics in science, different papers refer to the consistent lack of reproducibility of results and to the motivations behind scientific misconduct (Ioannidis, 2005; Eisner, 2018; Fanelli, 2018).

One aspect that receives scant attention in discussions of ethics pertains to the reference list. Although several studies note, for example, ethnic and gender disparities in citations, these papers often prioritize the topic of discrimination over that of ethical consideration (Lariviere et al., 2013; Caplar et al., 2017; Chakravartty et al., 2018; Dworkin et al., 2020; Kozlowski et al., 2022). However, as demonstrated by pioneering works on this matter, inaccurate citation "… may result in broad acceptance of unfounded claims as fact" (Greenberg, 2009), leading to significant distortions in scientific understanding. Many articles on this issue, (Robinson and Goodman, 2011; Leung et al., 2017; Stang et al., 2018, just to name a few), support the view that maintaining an unbiased and comprehensive reference list in research papers is an ethical imperative.

Acknowledging pioneers, giving credit to related work, and providing background reading are the foundations of scientific citation. Unfortunately, other more subjective or even questionable criteria can be used when constructing reference lists. This behavior gives rise to citation distortions, like inappropriate self-citations, wrong, honorary or reciprocal citations, gender and race bias (Vickers, 1995; Taylor, 2002; Corbyn, 2010; Ioannidis et al., 2019; Dworkin et al., 2020; Kozlowski et al., 2022; Jaffar et al., 2023), that we will further discuss below, which must be recognized as one of the many issues within the broader context of unethical practices affecting scientists, scientific publications, and the progress of science itself.

Moreover, although citations should be regarded solely as crucial for the honest and accurate dissemination of scientific knowledge, the reality is that they often serve other functions, like citation-based bibliometrics, diverting them from their true purpose. The proper use of bibliometric analysis can be seen as a valuable tool in science. However, it can be rather harmful when citation metrics are used to measure scientific excellence (Neylon, 2022). Indeed, it is undeniable that the frequency with which researchers are cited typically plays a decisive

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role in their career advancement. Regrettably, academic institutions, funding agencies, and even many in the scientific community often use citation metrics, either explicitly or implicitly, to gauge research excellence, impact, and productivity. In this way, distortions in reference lists expand their negative effects, hindering not only the accurate dissemination of science but also compromising a reliable evaluation of scientists. The repercussions of divergent citation rates extend beyond individual researchers to affect the scientific community at large. Unequal citation practices perpetuate the marginalization of underrepresented voices in academia, where lack of recognition further stifles the ability of researchers to contribute meaningfully to their fields.

The list of usual mistakes in citations is extensive, including, the rarity of original citations (scientists refer either to reviews or to papers with similar results instead of mentioning the paper that initiated a new paradigm. This common practice condemns the original authors to eventually fade into obscurity and for young scientists to remain unaware of the true origin of the result, perpetuating the error indefinitely); inappropriate self-citations, overlooking previous similar results or driven solely by self-promotion (Ioannidis et al., 2019); intentional or unintentional wrong citations (Vickers, 1995; Taylor, 2002); reciprocal citations, when groups of researchers cite each other's works extensively (Corbyn, 2010; Jaffar et al., 2023); gender and race/ethnic bias, whereby women or nonwhite scientists are cited less frequently relative to the number of papers they contribute to a given field (Lariviere et al., 2013; Caplar et al., 2017; Chakravartty et al., 2018; Dworkin et al., 2020; Kozlowski et al., 2022). Honorary citations (which in some cases involve coercive authorship) and ghost authorship (where individuals who have made substantial contributions to the work are not named as authors), which is itself coercive (Wislar and Fontanarosa, 2011), are evident unethical practices that violate the accuracy of reference lists. These practices give credit to individuals who did not contribute to the manuscript or hide the merit of those who deserve recognition.

Possibly less acknowledged contributors to citation distortion, yet equally significant, are global disparities. We wish to delve deeper into this distortion, as it remains an overlooked focus in the literature, and most scientists are unaware of its importance and consequences.

International- or region-based citation bias consists in scientific research from rich countries or regions being more widely cited than comparable studies from poorer nations or regions. A recent global analysis looking at nearly 20 million papers spanning at least 150 scientific fields identifies that while on the surface, science seems more international than ever, global/regional citation bias is steadily growing, imposing distortions on the circulation of knowledge, scientific progress, and innovation (Gomez et al., 2022). Using a framework based on textual similarity that allows identification of where citations should appear but are absent, the authors constructed a map to compare citational distortion by transnational region for a given year (Fig. 1).

The factors that could contribute to international citation bias, are far from clear and possibly deeply intertwined. However, several reasons can be identified:

1. The country of origin, based on the premise that papers from developing countries with less budget for research are less rigorous. Although it is true that low budgets hamper the use of cutting-edge techniques, this should not affect research rigor.
2. The conception that corruption, that in many cases is a hallmark of underdeveloped countries, could spill over to its scientific community rendering scientific output from these countries questionable and thus not worthy of citation. A recent article showing that Saud Arabia, Pakistan, Russia and China have the highest retraction rate among countries with >100000 research papers published in the last two decades (Van Noorden, 2023), seems to support this idea, since the degree of corruption in these four countries is rather high (Transparency International, 2023). However, this conclusion is not so straightforward because there are several other dishonest causes for retraction. For instance, retraction and fraud, may be also associated with bonus for publishing in high impact journals, being China and Saud Arabia the countries that give the highest awards per published paper (Abritis and McCook, 2017). Of note, these awards are often unattainable in underdeveloped or developing countries. In any case, whether deserved or not, the corruption index of a country may undeservedly affect the citation rate of its researchers due to simple prejudice.
3. The fact that scientists from low-income countries have less opportunities to showcase their research in international forums. This could make other scientists less prone to cite research that is not in their visual field.
4. Related to the previous point, scientists from low-income countries face much greater difficulties in publishing their results. In some cases, unprofessional peer reviewers hold prejudices regarding the country or the last names of the authors (Silbiger and Stubler, 2019). However, a more general cause could be found in the mechanism known as APC (article processing charges), which has been gaining prominence, whereby journals charge authors for publishing their articles (Borrego, 2023). These costs are unaffordable for the scientific systems of low-and even middle-income countries. Authors from these countries are often obliged to publish in journals that do not require payment, many of which have low impact factors, reducing

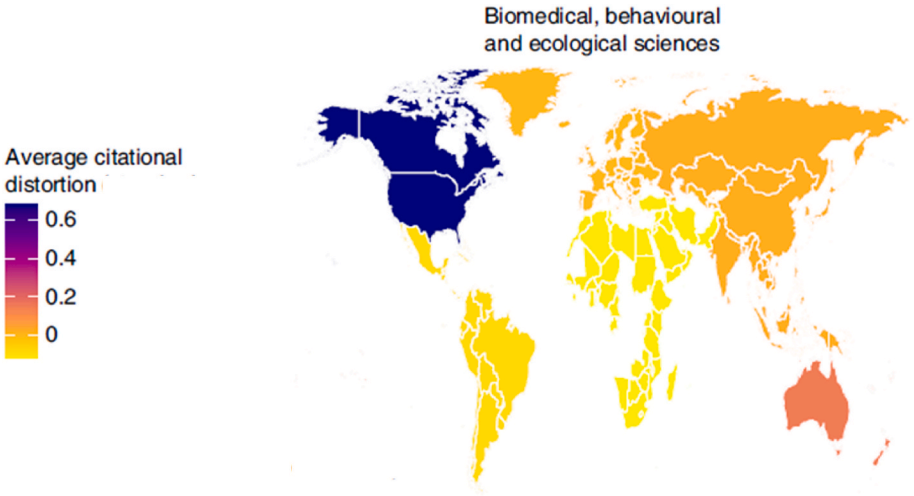

Fig. 1. The figure clearly reveals that scientific communities increasingly center research from highly active countries while overlooking work from peripheral countries (Modified from Gomez et al., 2022).

the visibility of their manuscripts. While exemptions are available, they are granted through individual negotiations. Even though major publishers waive article-processing charges for authors from low-income countries, these authors make up less than 1 percent of the total, which clearly indicates that it is essential to enhance the effectiveness of publishers' waiver policies (Asai, 2021). In many cases, the costs are covered through partnerships with authors from other countries who provide the necessary funds. These potential arguments not only reflect systemic inequalities but also have significant implications for the recognition, career advancement, and funding opportunities of researchers worldwide.

5. Another important factor that should be considered is the carelessness with which reference lists are often constructed. Several years ago, we wrote a manuscript discussing the impact of liquid modernity (Bauman, 2000) on scientific behavior (Mattiazzi and Vila-Petroff, 2021). At that time, we did not consider the construction of the reference list. However, we now realize that reference lists, as currently constructed, may indeed reflect the influence of liquid behavior—negligent, expedient, and thus susceptible to errors. On many occasions, construction of the reference list is considered a waste of time, and the main author does not participate in making it, delegating this task to a younger author who might not be aware of the correct references. This represents a significant ethical breach by the principal author, who also passes their negligence on to younger scientists. Another common way scientists try to save time when creating the reference list is by utilizing the various citation systems available. While these systems can be very helpful, they may also contribute to introducing reference inaccuracies that can unwittingly be perpetuated, if these systems are not applied with full awareness. Possibly one of the best examples of negligent behavior when doing the reference lists is offered by the article of Anne -Wil Harzing about the puzzling and disquieting finding of Professor Pieter Kroonenberg, about a non-existing article being cited nearly 400 times (Harzing and Kroonenberg, 2017).
6. The lack of serious investment in science in the low- and middle-income countries. Indeed, there is a correlation between substantial investment in science and technology and the increase in citations of manuscripts of these countries. A typical example is China where, according to the analysis of Gomez et al. (2022), the great increase in science investment in the last 30 years has increased the citation rate. Although this is a mere correlation and does not reveal a cause-and-effect action, it is reasonable to expect that increasing the number of publications and authors visibility, will increase the frequency with which a given article is cited.

One may inquire at this point whether global disparities in citation constitutes a simple observation or should be considered, as the other mentioned distortions, an ethical issue that should be acknowledged and seriously revised. By simply reviewing the possible causes of global disparities in citations, one has to acknowledge that many of them constitute ethical issues by either prejudgment or lack of rigor when making the citation list. At the very least, overlooking research from broad sections of the global scientific community harms individual researchers and, more importantly, means that valuable knowledge remains unincorporated and human capital underutilized. Raising awareness of this bias and better identifying under-cited countries would promote the inclusion of often-excluded perspectives while also enhancing overall knowledge production.

Addressing citation bias is not straightforward and requires awareness and active measures to ensure that all relevant research is fairly considered and cited. The international scientific community should compile their reference lists with the same seriousness and integrity as they apply to all other aspects of their research. From the perspective of editors and publishers, a possible strategy could be to send manuscripts to reviewers without including the authors' names and affiliations. This practice would help ensure an unbiased review process. In addition, research journals might consider including reference list reviewers, similar to how they employ special statistical and technical reviewers. We feel that this is not an overstatement, given the significant impact citation distortions can have on the progress of knowledge.

We believe however that the most challenging burden likely falls on scientists from low and middle-income countries. They should not remain passive in their frustration, waiting for solutions from elsewhere. We believe that it is critical that they inform the editors when they feel their work has not received proper citation. Additionally, they should advocate for publishers to waive publication fees for researchers from low-and middle -income countries and strive to increase investment in science within their own nations.

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CRediT authorship contribution statement

Alicia Mattiazzi: Writing – original draft, Writing – review & editing, has conceived and write the article. **Martin Vila-Petroff:** Writing – original draft, Writing – review & editing, Petroff has conceived and write the article, Hereby I declare that all descriptions are accurate and agreed by all authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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