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EDITED BY
Mario R. Moura,
Federal University of Paraíba, Brazil

REVIEWED BY
Ruth Oliver,
University of California, Santa Barbara, United States
Taline Cristina Da Silva,
State University of Alagoas, Brazil

*CORRESPONDENCE
Flávia Virginio
flavia.virginio@butantan.gov.br

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Productivity in academia: When the rules determine the losers

Luisa Maria Diele-Viegas[1,2,3], Lilian P. Sales[2,4], Veronica Slobodian[3,5], Flávia Virginio[2,3,6]*, Shirliane de Araújo Sousa[3,7], Daniela Pareja-Mejía[2,8], Christine D. Bacon[9,10], Allen S. X. Mugarte[11], Iris Amati-Martins[2,12], Fernanda Dias-Silva[2,3,13,14], Olivia G. S. Araújo[2,15], Jann Nassif[16], Murillo Carvalho[2,17], Camila Luz[2,17], Bruno Eleres Soares[18], Rodrigo V. Pêgas[19] and Lucy G. Souza[2,20,21,22]

[1]Biology Institute, Federal University of Bahia, Salvador, Bahia, Brazil, [2]Kunhã Asé Network of Women in Science, Salvador, Bahia, Brazil, [3]Women in Zoology Network, Instituto de Ciências Biológicas, Brasília University, Campus Universitário Darcy Ribeiro, Brasília, Brazil, [4]Department of Biology, Concordia University, Montreal, QC, Canada, [5]Laboratory of Systematic Ictiology, Department of Zoology, Institute of Biological Sciences, Brasilia University, Campus Universitário Darcy Ribeiro, Brasília, Brazil, [6]Research Group in Medical Entomology, Laboratory of Zoological Collections, Butantan Institute, São Paulo, Brazil, [7]Education College of Crateús, State University of Ceará, Crateús, Ceará, Brazil, [8]Graduate Program in Zoology, State University of Santa Cruz, Ilhéus, Bahia, Brazil, [9]Department of Biological and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden, [10]Gothenburg Global Biodiversity Centre, Gothenburg, Sweden, [11]Institute of Biological Sciences, Federal University of Amazonas, Campus Universitário Senador Arthur Virgílio Filho, Manaus, Amazonas, Brazil, [12]Landscape Ecology and Conservation Lab, Department of Ecology, Institute of Biosciences, São Paulo University, São Paulo, SP, Brazil, [13]Laboratory of Amphibian Biosystematics, Department of Zoology, Institute of Biosciences, Federal University of the Rio de Janeiro State, Rio de Janeiro, RJ, Brazil, [14]Herpetology Sector, Department of Vertebrates, National Museum, Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil, [15]Department of Biodiversity, Institute of Biosciences, State University of São Paulo, Rio Claro, São Paulo, Brazil, [16]Department of Biological Sciences, Ohio University, Athens, OH, United States, [17]Biology Institute, Federal University of Bahia, Salvador, Bahia, Brazil, [18]Department of Biological Sciences, University of Toronto-Scarborough, Toronto, ON, Canada, [19]Laboratory of Vertebrates Paleontology and Animal Behavior, Federal University of ABC, São Bernardo Do Campo, SP, Brazil, [20]Faculdade Estácio Do Amazonas, Manaus, AM, Brazil, [21]Graduate Program of Zoology, Federal University of Amazonas, Manaus, AM, Brazil, [22]Graduate Program of Genetics, Conservation and Evolution Biology, National Institute of Amazonian Research, Manaus, AM, Brazil

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Primary text

Academic productivity is often defined as the number of published scientific articles, citations, and grants a scientist achieves (Sarli and Carpenter, 2014). It is considered an objective metric of a researcher's impact or ability in their field (Sarli and Carpenter, 2014) and is used to rank competitors for research funding, job openings, and other competitions (Bol et al., 2018). However, systematic biases against traditionally marginalized groups (women, people with disabilities, BIPOC—black, indigenous, and people of color, people from the Global South, and 2SLGBTQIA+–two-spirit, lesbian, gay, bisexual, transgender, queer, intersexual, asexual, and others), can impact their productivity, making the currently used academic productivity metric a biased index of scientific merit, besides also impacting the way that this productivity is evaluated. Such systematic biases are demonstrated by empirical evidence, which we discuss below.

Among articles published in journals listed in the Nature Index between 2008 and 2016, only 33.1% were led by a woman, and 18.1% have women as senior authors (last authorship) (Bendels et al., 2018). In addition, among leading journals in ecology, evolution, and conservation, not only women are underrepresented as first authors, but also people from countries of the Global South (Mass et al., 2021). Despite the presumed impartiality and objectivity in editorial decisions and peer-review, social stereotypes are likely to have a role in the biases against female authors by their (primarily male) editors and reviewers (Liévano-Latorre et al., 2020). In addition, women are less likely to be cited even if presenting the same number of publications in the same journal profile as men (Fox and Paine, 2019), thus receiving less peer recognition for their work and hampering their scientific impact (Rossiter, 1993). Women must publish twice as many papers to be considered as competent as men (Wennerås and Wold, 1997). In an experiment evaluating applicants for a laboratory manager position with an identical Curriculum randomized to assign female or male names (Moss-Racusin et al., 2012), male applicants were rated significantly more competent and hireable than identical female applicants (Wennerås and Wold, 1997), highlighting the gender bias in academic evaluation.

Although these effects are well-known for cisgender women (i.e., those whose gender self-identification corresponds to binarization), the intersections with other underrepresented groups are likely to potentiate existing biases (Metcalf et al., 2018). For instance, *impostorism* [i.e., the lack of confidence in one's ability or intelligence despite evidence of high performance (Clance and Imes, 1978)] disproportionately affects African American female students, often leading to higher levels of anxiety and discrimination–related depression (Cokley et al., 2017). Not surprisingly, female researchers from ethnic minorities and non-traditional gender identities or sexual orientations are rare in most academic leadership positions (Nelson, 2019; Aguirre, 2020). Such a lack of role models and vulnerability-specific mentoring undermines self-confidence and magnifies impostorism and related mental health issues for these underrepresented (Hinton et al., 2020), ultimately creating toxic workplaces (Chrousos et al., 2020). The 2SLGBTQIA+ community, for example, reports higher levels of harassment, bullying, or exclusionary behavior in the scientific environment (Gibney, 2019), which directly affects productivity (Aguirre, 2020). Such issues favor traditionally dominant and privileged groups, such as middle-aged, white, male, and cisgender scientists from developed countries with a more extensive research network of similar peers, who face fewer setbacks in their scientific education and thus are likely to present more established careers (Bol et al., 2018; Diele-Viegas et al., 2021). Therefore, people from underrepresented groups are supposed to play the same "game" but are, from the beginning, penalized by the underlying "rules."

The systematic biases on productivity render the implicit synonymization between a "good leader" or "successful researcher" with a "productive scientist." However, asymmetries in evaluation systems further benefit previously successful scientists, leading to the *Matthew Effect*, or positive feedback in which people from privileged groups are more likely to have won prior grants or awards and thus receive more favorable evaluations than people from marginalized groups (Bol et al., 2018). On the other hand, early-career researchers and people from marginalized groups are usually prejudiced in the race for funding, being systematically underfunded (Woolston, 2020; Stevens et al., 2021). This award-winning feedback ultimately forces marginalized groups to cope with repeated rejections, undermining their personal and professional development (Jaremka et al., 2020).

To address the inequalities mentioned above in the professional outcomes of underrepresented groups in academia and develop solutions, we must first recognize the structural biases related to the current criteria of productivity, success, and leadership. Then, we must offer solutions considering the inequalities to balance this unbalanced competition and implement strategies to support the underrepresented groups in achieving their goals. Herein, we list several strategies that can be undertaken to achieve more equitable and fair academia by balancing the competition. The suggested strategies are not exhaustive, but we consider anecdotal evidence based on our experiences as researchers from underrepresented groups in STEM fields and, more importantly (Hipólito and Diele-Viegas, 2022), empirical data from recent studies published on this topic.

Balancing the competition

Strategies to mitigate biases on the academic race to a successful career must account for the multiple layers of discrimination pervasive in STEM fields as a reflection of our society (Figure 1). A first step toward avoiding systematic biases in the scientific competition is to guarantee diversified evaluation committees, editorial and peer-review boards, scientific society boards, and scientific meeting convenors. Affinity bias (the tendency to prefer people like yourself) can be a powerful weapon to rebalance inequalities if used not for, but against academia's homogeneity, especially in STEM (Demarest et al., 2014).

Strategies to minimize minority productivity gaps should specifically target its causes. Affirmative policies can be implemented to rebalance scientists' recruiting from underrepresented groups (Diele-Viegas et al., 2021). Strategies to mitigate minority productivity gaps should specifically target its causes. In this context, it is essential to highlight that the demands and adjustments of social evaluations are not about privileges, but about recognizing the biased conditions these marginalized, underrepresented, and disadvantaged groups

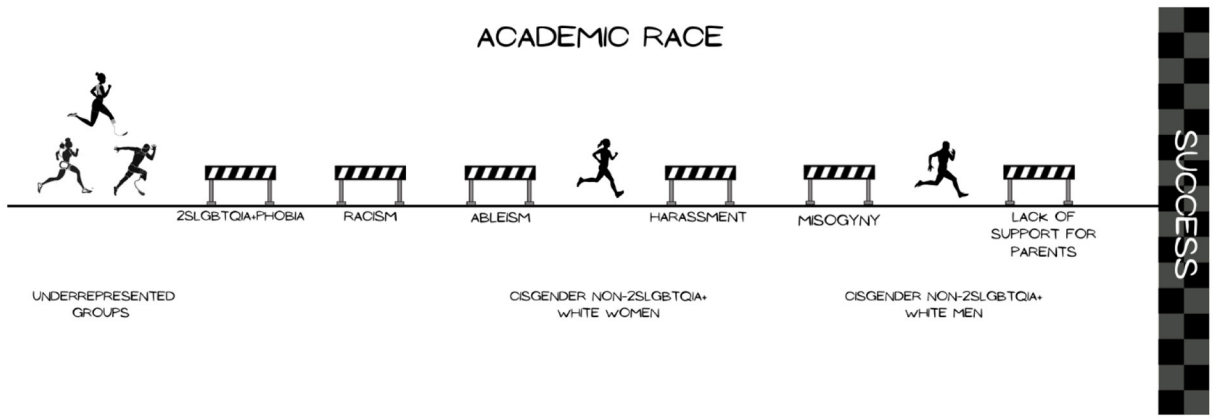

FIGURE 1
Academic race and its obstacles for a successful career in STEM considering the intersections between underrepresented groups. 2SLGBTQIA+ = Two-spirit, lesbian, gay, bisexual, transgender, queer, intersexual, asexual, and others.

experience given the social structure we are immersed in, analyzing their specific reality, and requiring the appropriate specialized and differentiated assistance they need. In other words, academia replicates the social inequalities, and we must take them into consideration to promote a more equitable space.

For instance, women, parents (especially mothers), caregivers, and social and ethnic marginalized groups are disproportionately burdened with household chores (Goulden et al., 2011), especially under social isolation and child homeschooling during the COVID pandemic (Hipólito et al., 2020). Therefore, their productivity should not be evaluated under the same standards (Hipólito et al., 2020). It is crucial to consider a different period of scientific activity for productivity evaluations based on maternal/parental leaves and other personal-related leaves from work (Hipólito et al., 2020). In addition, allowing for different submission modalities or implementing flexible deadlines (Ahn et al., 2021) for grant proposals, reports, and returning reviews could be essential to improve their productivity rates (Mogro-Wilson et al., 2022). Post-pandemic nurseries, daycare centers, and flexible and reduced working hours will benefit academic mothers and caregivers (Hipólito et al., 2020).

To retain and promote scientists from underrepresented groups, scientific institutions must also ethically divide the communal, administrative, and mentoring labor among researchers at different stages of their careers so that minority and early-career scientists can protect their research time and gain proper recognition for their work (Mogro-Wilson et al., 2022). Nevertheless, aspects of teaching time and quality, mentorship (especially of undergraduate students who demand more significant effort and investment), university outreach projects, and student-focused services in scientific and educational institutions should also be considered in science competitions. These activities are usually undervalued, time-consuming, and penalize investment in publications but are of pivotal importance in young scientists' training and societal development (Bird et al., 2004).

Therefore, as (mostly) early-career scientists from underrepresented groups, we urge that the criteria used to evaluate STEM productivity, success, and leadership capacity must be broader and diversified, avoiding a quantitative metric exclusively focused on paper production and impact factor (Abramo et al., 2011). We stress the urgency to weigh traditionally accepted metrics of productivity and leadership, such as the number of published papers or the h-index, by historical intersectional layers of oppression to which grantees have been subjected. Further, guaranteeing a diversified evaluation board regarding ethnicity, gender, sexual identity, and geographical origin allows different narratives to be voiced equally and better evaluated, leading to more inclusive graduate programs for students and faculty.

Concerning the funding agencies, we recommend more inclusive application forms considering gender and race/color/ethnicity identity (Sato et al., 2020). We also recommend that funding agencies follow the peer-review process of scientific journals and provide unsuccessful applicants with more precise, accessible, and explanatory information on their evaluation scores and rejection decisions. This transparency and objectiveness may encourage near winners to conclude that the future odds are worth investing additional time and effort in a new application, besides directing efforts to the evaluation elements that were less scored and need improvement.

Finally, we must recognize, systematize, and understand the social biases that academia falls prey to. Diversity data collection is crucial for mapping the social structure of

academia and understanding the patterns of who is winning (and who is losing). Some institutions are using this data to balance the competition by implementing specific actions, such as fellowships for underrepresented groups (e.g., United Negro College Fund; https://uncf.org/scholarships). Nonetheless, this is not generalized for funding agencies everywhere, and some underrepresented groups still lack representation in standardized large-scale diversity data collection. For example, the 2SLGBTQIA+ are often misrepresented by having the option to self-identify with only the most mainstream identities (gay, lesbian, bi), and multiple equally valid identities are left out. Therefore, we support large-scale attempts to collect data on diversity, but it needs to be aligned and directed by the people in these underrepresented groups.

Most of the authors of this piece belong to the Kunhã Asé Network of Women in Science (RKA), a female-led, Latin-American non-governmental and collaborative initiative anchored on the principle that diverse participation in STEM is a fundamental step toward building a fairer society for all. In conclusion, we believe that the different identities, characteristics, and personalities must be stimulated across scientific fields during all academic careers. Thus, we believe that a comprehensive approach focused on increasing diversity in academia, besides ethical value *per se*, will breed innovation once underrepresented groups produce higher scientific novelty (Hofstra et al., 2020). Thus, we urge more comprehensive evaluation criteria to replace the current definition of productivity, leadership capacity, and scientific merit in the researchers' evaluation. A more ethical venue to rank researcher competitors to combat known biases in academia is highlighting the applicant's quantitative accomplishments, background, and personal context. Such change is urgently required if academia intends to be a fair arena where early-career researchers or underrepresented groups are not penalized and set aside from the game. As we move toward the post-pandemic world, diversity, equity, and inclusion must be explicitly acknowledged and accounted for in science competitions.

Author contributions

LD-V, LS, and FV made the study conception. LD-V, FD-S, and FV made the figure. All authors contributed to data collection and manuscript writing. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Abramo, G., D'Angelo, C. A., and Di Costa, F. (2011). Research productivity: are higher academic ranks more productive than lower ones? *Scientometrics* 88, 915–928. doi: 10.1007/s11192-011-0426-6

Aguirre, A. (2020). *Women and Minority Faculty in the Academic Workplace: Recruitment, Retention, and Academic Culture*. San Francisco, CA: ERIC.

Ahn, S. J., Cripe, E. T., Welles, B. F., McGregor, S. C., Pearce, K. E., Usher, N., et al. (2021). Academic Caregivers on Organizational and Community Resilience in Academia (Fuck Individual Resilience). *Commun. Cult. Critique* 14, 301–305. doi: 10.1093/ccc/tcab027

Bendels, M. H. K., Müller, R., Brueggmann, D., and Groneberg, D. A. (2018). Gender disparities in high-quality research revealed by nature index journals. *PLoS ONE* 13, e0189136. doi: 10.1371/journal.pone.0189136

Bird, S., Litt, J., and Wang, Y. (2004). Creating status of women reports: institutional housekeeping as "women's work'. *NWSA J.* 16, 194–206. doi: 10.2979/NWS.2004.16.1.194

Bol, T., de Vaan, M., and van de Rijt, A. (2018). The Matthew effect in science funding. *Proc. Natl. Acad. Sci. U. S. A.* 115, 4887–4890. doi: 10.1073/pnas.1719557115

Chrousos, G. P., and Mentis, A.-., F. A. (2020). Imposter syndrome threatens diversity. *Science* 367, 749–750. doi: 10.1126/science.aba8039

Clance, P. R., and Imes, S. A. (1978). The imposter phenomenon in high achieving women: Dynamics and therapeutic intervention. *Psychother. Theor. Res. Pract.* 15, 241–247. doi: 10.1037/h0086006

Cokley, K., Smith, L., Bernard, D., Hurst, A., Jackson, S., Stone, S., et al. (2017). Impostor feelings as a moderator and mediator of the relationship between perceived discrimination and mental health among racial/ethnic minority college students. *J. Counsel. Psychol.* 64, 141–154. doi: 10.1037/cou0000198

Demarest, B., Freeman, G., and Sugimoto, C. R. (2014). The reviewer in the mirror: examining gendered and ethnicized notions of reciprocity in peer review. *Scientometrics* 101, 717–735. doi: 10.1007/s11192-014-1354-z

Diele-Viegas, L. M., Cordeiro, T. E. F., Emmerich, T., Hipolito, J., Queiroz-Souza, C., Sousa, E., et al. (2021). Potential solutions for discrimination in STEM. *Nat. Hum. Behav*. 5, 672–674. doi: 10.1038/s41562-021-01104-w

Fox, C. W., and Paine, C. E. T. (2019). Gender differences in peer review outcomes and manuscript impact at six journals of ecology and evolution. *Ecol. Evol*. 9, 3599–3619. doi: 10.1002/ece3.4993

Gibney, E. (2019). Discrimination drives LGBT+ scientists to think about quitting. *Nature* 571, 16–17. doi: 10.1038/d41586-019-02013-9

Goulden, M., Mason, M. A., and Frasch, K. (2011). Keeping Women in the Science Pipeline. *Ann. Am. Acad. Pol. Soc. Sci.* 638, 141–162. doi: 10.1177/0002716211416925

Hinton, A. O., Vue, Z., Termini, C. M., Taylor, B. L., Shuler, H. D., and McReynolds, M. R. (2020). Mentoring minority trainees: minorities in academia face specific challenges that mentors should address to instill confidence. *EMBO Rep*. 21, e51269. doi: 10.15252/embr.202051269

Hipólito, J., and Diele-Viegas, L. M. (2022). Stop using anecdotal evidence in conversations about gender. *Nature* d41586-022-00462–3. doi: 10.1038/d41586-022-00462-3

Hipólito, J., Diele-Viegas, L. M., Cordeiro, T. E. F., Sales, L. P., Medeiros, A., Deegan, K. R., et al. (2020). Unwrapping the long-term impacts of COVID-19 pandemic on Brazilian academic mothers: the urgency of short, medium, and long-term measures. *An. Acad. Bras. Ciênc.* 92, e20201292. doi: 10.1590/0001-3765202020201292

Hofstra, B., Kulkarni, V. V., Galvez, S. M. -N., He, B., Jurasfsky, D., and McFarland, D. A. (2020). The diversity–innovation paradox in science. *Proc. Natl. Acad. Sci. U. S. A*. 117, 9284–9291. doi: 10.1073/pnas.1915378117

Jaremka, L. M., Ackerman, J. M., Gawronski, B., Rule, N. O., Sweeny, K., Tropp, L. R., et al. (2020). Common academic experiences no one talks about: repeated rejection, impostor syndrome, and burnout. *Perspect. Psychol. Sci*. 15, 519–543. doi: 10.1177/1745691619898848

Liévano-Latorre, L. F., Silva, R. P., Vieira, R. S., Resende, F. M., Ribeiro, B. R., Borges, F. J. A., et al. (2020). Pervasive gender bias in editorial boards of biodiversity conservation journals. *Biol. Conserv*. 251, 108767. doi: 10.1016/j.biocon.2020.108767

Mass, B., Pakeman, R. J., Godet, L., Smith, L., Devictor, V., Primack, R., et al. (2021). Women and Global South strikingly underrepresented among top-publishing ecologists. *Conserv. Lett*. e12797, 1–9. doi: 10.1111/conl.12797

Metcalf, H., Russell, D., and Hill, C. (2018). Broadening the Science of Broadening Participation in STEM Through Critical Mixed Methodologies and Intersectionality Frameworks. *Am. Behav. Sci.* 62, 580–599. doi: 10.1177/0002764218768872

Mogro-Wilson, C., Negi, N., Acquati, C., Bright, C., Chang, D. F., Goings, T. C., et al. (2022). Reflections From Academic Mothers of Young Children on Social Work Research and Education. *J. Soc. Work Educ.* 58, 9–33. doi: 10.1080/10437797.2021.2014726

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., and Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proc. Natl. Acad. Sci.* 109, 16474–16479. doi: 10.1073/pnas.1211286109

Nelson, R. G. (2019). Racism in science: a lingering taint. *Nature*. 570, 2. doi: 10.1038/d41586-019-01968-z

Rossiter, M. W. (1993). The Matthew Matilda effect in science. *Soc. Stud. Sci* 23, 325–341. doi: 10.1177/030631293023002004

Sarli, C. C., and Carpenter, C. R. (2014). Measuring Academic Productivity and Changing Definitions of Scientific Impact. *Missouri Med*. 111, 399. Available online at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4983716/

Sato, S., Gygax, P. M., Randall, J., and Schmid Mast, M. (2020). The leaky pipeline in research grant peer review and funding decisions: challenges and future directions. *High. Educ*. 82, 145–162 doi: 10.1007/s10734-020-00626-y

Stevens, K. R., Masters, K. S., Imoukhude, P. I., Haynes, K. A., Setton, L. A., Cosgriff-Hernandez, E., et al. (2021). Fund Black scientists. *Cell* 184, 561–565. doi: 10.1016/j.cell.2021.01.011

Wennerås, C., and Wold, A. (1997). Nepotism and sexism in peer-review. *Nature*. 387, 341–343. doi: 10.1038/387341a0

Woolston, C. (2020). Pandemic darkens postdocs' work and career hopes. *Nature* 585, 309–312. doi: 10.1038/d41586-020-02548-2