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Viewpoint

Guidelines for Intersectional Analysis in Science and Technology: Implementation and Checklist Development

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Abstract

Intersectional analysis goes beyond consideration of single variables to examine the compounded impact at the intersections of, for example, gender and race, or geographical location and caste. The Guidelines for Intersectional Analysis in Science and Technology (GIST) help researchers, journal editors, and funding agencies systematically integrate intersectional analysis into relevant domains of science and technology. These guidelines serve as a roadmap for quantitative intersectional analysis throughout the research process—from setting strategic research priorities and shaping research questions to data collection, analysis, and interpretation. Here we provide a checklist to facilitate author and journal editor compliance with the guidelines. We recommend that the GIST checklist be added to journals' "Information for Authors". The goal is to reset the research default to include intersectional analysis, where appropriate. Intersectional analysis leads to better science: precision in research best guides effective social and environmental policies that, in turn, enhance global equity and sustainability.

Keywords:

Editorial process, Intersectional analysis, Information for authors, Research equity, Sex and Gender Equity in Research

Introduction

Over the past decade, peer-reviewed journals have embraced the concept of reporting and analysing sex and gender in research, where appropriate and feasible, and many have endorsed the Sex and Gender Equity in Research (SAGER) guidelines.[1] Similarly, many journals, including *JAMA*,[2] *Nature*,[3,4] and *The Lancet*,[5] have published guidance for reporting race, ethnicity, and other social variables. But these single-issue approaches can miss the compounded impact at the intersections of, say, gender and race, or geographical location and caste, or sexual orientation and migration status. The danger is that if the relevant variables are not considered, researchers risk amplifying existing inequities, both societal and environmental.

To address this, we developed the Guidelines for Intersectional Analysis in Science and Technology (GIST).[6] The Guidelines aid researchers, journal editors, and funding agencies to systematically integrate intersectional analysis into relevant domains of science and technology. These guidelines serve as a roadmap for quantitative intersectional analysis throughout the research process—from setting strategic research priorities and shaping research questions to data collection, analysis, and interpretation.

There are many examples of how an intersectional approach can lead to better outcomes. An iconic example is facial recognition technology, commonly used in personal devices such as smartphones and security systems.[6] In a study by Buolamwini and Gebru,[7] the gender analysis showed that the systems performed better on men's faces than on women's faces. The skin tone analysis showed that the systems performed better on lighter skin than on darker skin. But the intersectional analysis provided a more complete picture: the system performed worst for darker-skinned women. Buolamwini and Gebru's intersectional analysis led technology companies to release new AI models that improved performance across their systems.[8] This "intersectional innovation" helped create technology that worked for more people globally. Many other examples exist across various disciplines—from the intersectional burdens of energy failure in rural South Africa to intersections of gender and religious preference that can lead to privileging boys' health over girls' health in Muslim communities.[6]

The term "intersectionality" was coined in 1989 by legal scholar Kimberlé Crenshaw[9] to describe how multiple forms of discrimination, power, and privilege intersect in Black women's lives, in ways that are not evident when sexism and racism are treated separately. Since that time, the term has been expanded to describe intersecting forms of oppression and inequality emerging from structural advantages and disadvantages that shape a person's or a group's experience and social opportunities.[10] Originally developed in the humanities and social sciences, intersectional analysis has since expanded to public health and labour economics. Current challenges in technology (e.g. potential risks of AI) and environmental sciences (accelerating climate change) make it crucial to apply intersectionality to quantitative fields.

For quantitative analysis, we conceptualize intersectional factors at three interconnected levels: *socio-political dimensions*—such as sex, gender, ethnicity, caste, religion and sexuality. These are embedded in larger *contextual domains*, such as legal, healthcare, or educational institutions, and these two co-constitutive levels are further embedded in *environmental conditions*—or planetary systems—such as air, soil, and water quality. It is understanding the push and pull of these three basic levels that is important for intersectional analysis.

The GIST guidelines are intended to be valid for publishing in peer-reviewed journals across the globe. Important to our methodology in creating the guidelines was assembling a global group of authors, with representatives from Africa (Kenya and South Africa), Asia (China and South Korea), Europe (Denmark, Italy, Switzerland, and the UK), and the USA. Our second strategy was to assemble a multidisciplinary group of authors. These authors were selected to ensure that we had expertise across the required disciplines. Several of our authors came from sociology, history of science, African-American studies, and information studies—disciplines important to the development of *qualitative* and *quantitative* intersectional analyses in the social sciences, and thus crucial to our work. In our efforts to expand these methods to the natural sciences and technology, we recruited authors from marine science, public health, climate change and planetary health, food and nutrition, energy and environment, chemistry, computer science, electrical engineering, and race and digital justice. With this global, multidisciplinary group, we sought to ensure that the intersectional factors we described and the way we illustrated them through examples made sense in different geographical locations and disciplines. We know, for example, that race, when used as a category of analysis in South Africa, is conceptually different than when used in the USA. We wanted to be very careful with varying cultural and environmental contexts.

In addition, some of our authors have been involved in developing the intellectual foundations for policies for funding agencies, such as the European Commission, the National Research Foundation of South Africa, the US National Institutes of Health, and the Global Research Council, an umbrella organization for public research funders.[11] Others of us authors are editors of major peer-reviewed journals. One author was instrumental in developing the SAGER guidelines. We were keen to have these experiences and varied perspectives: are our authors' recommendations practical? Do they work in varying policy contexts? Are they culturally sensitive?

Through these processes, we defined and developed GIST to serve as a roadmap for quantitative intersectional analysis. We adopted the basic Gendered Innovations approach that guides researchers through the research process—from setting strategic research priorities and shaping research questions to data collection, analysis, interpretation, and dissemination—an approach we used to organize our *Nature* paper.[6] In each step, we offered methodological strategies extracted from examples across various disciplines—with a focus, where possible, on AI and climate change.

The long-term goal is to fully integrate intersectional analysis into undergraduate and graduate core curricula in the natural sciences, medicine, and technology fields. In many instances, professors may need assistance to accomplish this. The Embedded EthiCS movement may offer a model.[12] To embed social analysis into core computer science courses, computer scientists have teamed up with social scientists and humanists to teach these skills.[13] Introducing relevant aspects of intersectional analysis into technical courses may follow a similar joint-teaching approach, tailored to specific university structures. As an interim strategy, funding agencies and peer-reviewed journals can provide publication guidelines for what constitutes excellence in science and technology. By adopting the GIST guidelines, agencies and journals support best practices for designing and reporting research.

We emphasize that intersectional analysis should be implemented "where relevant", because this approach may not be applicable to some domains of science, for example, certain subfields of chemistry (e.g. polymer synthesis) or theoretical physics. Black holes, for example, have no sex, gender, or

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Table 1. Guidelines for Intersectional Analysis in Science and Technology Checklist

Section	Item	Checklist Item	Description	Reported on page number
General	1	Terminology	Check that all terms defining sociopolitical dimensions, contextual domains, and environmental conditions are defined clearly.	
Title	2	Signal in title	In studies where intersectional analysis is central, signal that in the title.	
Abstract	3a	Results mention	Where intersectional analysis is included in results, indicate this in the abstract.	
Abstract	3b	Specify coverage	Specify the populations and sociopolitical dimensions covered.	
Introduction	4a	Literature review	Highlight relevant findings from similar or past studies.	
Introduction	4b	Rationale and objectives	Specify background, rationale, objectives, and hypotheses for intersectional analysis.	
Introduction	4c	Dimensions and justification	Detail the sociopolitical dimensions, contextual domains, and environmental conditions covered, and consider how they may reflect relationships of power, privilege, and disadvantage; justify your choice.	
Methods	5a	Definitions and proxies	Offer precise definitions for each sociopolitical dimension, contextual domain, and environmental condition, and their sub-variables, if relevant. Avoid proxy variables; if used, justify and note caveats.	
Methods	5b	Measurement	Describe how each sociopolitical dimension, contextual domain, or environmental condition is measured.	
Methods	5c	Intersectional methods	Describe the methods used to examine intersectional effects across sociopolitical dimensions.	
Methods	5d	Sample size	Specify the required sample sizes for each subgroup to ensure sufficient statistical power. For nested data structures, ensure sufficient observations within each unit to identify contextual effects and estimate intersectional patterns linked to those contexts.	
Methods	5e	Multiplicative analysis	Intersectional analysis should capture *multiplicative* effects to reflect how intersecting dimensions, domains, and conditions compound inequality.	
Results	6a	Sample composition	Detail the sample's composition across intersectional dimensions.	
Results	6b	Full outcome reporting	Report all outcomes, including null results.	
Results	6c	Variability and overlap	Report within-group variability and between-group overlap to avoid overemphasizing differences.	
Results	6d	Data access	Make raw data, particularly those that are difficult to access, accessible while ensuring anonymity.	
Discussion	7a	Summary of results	Summarize key intersectional results.	
Discussion	7b	Limitations	Discuss limitations, whether due to study scale, data availability, or other factors.	
Discussion	7c	Generalizability	Discuss whether the results generalize to other populations.	
Discussion	7d	Power reflection	Reflect on how the results connect to questions of power, privilege, or specific contextual domains and environmental conditions.	
Discussion	7e	Impact	Highlight how your intersectional analysis has enhanced scientific accuracy, and, where relevant, how the resulting insights could lead to more equitable technological solutions or environmental policy interventions.	

Adapted from Nielsen MW, Gissi E, Heidari S, et al. Intersectional analysis for science and technology. Nature. 2025 Apr 10;640(8058):329-37.

socioeconomic status. We do not want to push a perspective where it is not relevant; however, researchers should think carefully about intersectionality before ruling it out.

Implementing the Guidelines

To facilitate the implementation of GIST, we have developed a checklist (Table 1). The checklist should be made available to authors to encourage clear and accurate reporting. By using this checklist as part of manuscript assessment and peer-review processes, journal editors can improve the rigour and reproducibility of the research they publish.

The checklist can be used at different stages of publication: by authors when designing their research; by editors when screening manuscripts for peer review; by reviewers when assessing manuscripts; and by authors and editors after the first round of review, particularly when the decision is to revise and resubmit. Given that intersectional analysis is not relevant to all science, editors should offer a box where authors can explain why they have not included it.

Next Steps

GIST has been endorsed by EASE https://ease.org.uk/publications/ease-statements-resources/. We encourage endorsement by similar associations and other organizations associated with research, particularly those that already support SAGER, such as COPE (EASE SAGER guidelines | COPE: Committee on Publication Ethics) and the World Health Organization.[14] Implementation will require scientific journals and organizations to incorporate GIST into formal editorial guidance and publication policies. Editors and publishers should add GIST to their Information for Authors in relevant journals and perhaps use it to develop specific guidance on reporting intersectional analysis, as Elsevier did for reporting sex- and gender-based analyses. Journals may use the GIST guidelines as a helpful resource and tailor them to their specific, disciplinary needs. Feedback on the potential guideline revisions may be sent to the corresponding author.

Conclusion

Research across relevant domains of science and technology, including AI, planetary health, and climate and marine science, should take intersectional analysis into account. This is not a political agenda: this approach is essential to ensure that scientific and technological research promotes rigorous and reproducible results. Intersectional analysis leads to better science: precision in research best guides effective social and environmental policies that, in turn, enhance global equity and environmental sustainability. The goal of the GIST project is to reset the research default to include intersectional analysis, where appropriate. The GIST checklist will facilitate that process, and we encourage its adoption by all concerned parties.

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