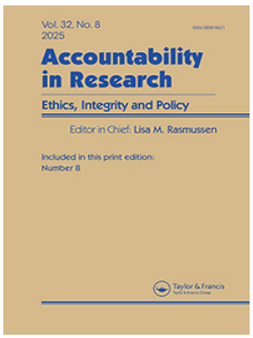

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Disclosing artificial intelligence use in scientific research and publication: When should disclosure be mandatory, optional, or unnecessary?

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ABSTRACT

Currently there is a broad consensus among scholars that artificial intelligence (AI) tools can be used in research and publication, and that their use should be disclosed. Publishers and influential organizations, like the International Committee of Medical Journal Editors, have developed different and sometimes contradictory disclosure policies. We review some of these policies, examine the ethical reasons for disclosing AI use in research, and develop a framework for disclosure. We distinguish between mandatory, optional, and unnecessary disclosure of AI use, arguing that disclosure should be mandatory only when AI use is intentional and substantial. AI use is intentional when it is directly employed with a specific goal or purpose in mind. AI use is substantial when it 1) produces evidence, analysis, or discussion that supports or elaborates on the conclusions/findings of a study; or 2) directly affects the content of the research/publication. To support the application of our framework, we state three criteria for identifying substantial AI uses in research: a) using AI to make decisions that directly affect research results; b) using AI to generate content, data or images; and c) using AI to analyze content, data or images. Disclosure should be mandatory when AI use meets one of these criteria.

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AI; ethics; disclosure; transparency; accountability

Introduction

More than two years after chatbots were first named as authors on scientific papers, the debate about using artificial intelligence (AI) in research and writing is taking a new turn. Initially, the debate focused on big-picture issues, such as whether it is ethical to use AI tools in writing scientific articles and whether AI tools can be named as authors (Hosseini, Rasmussen, and Resnik 2023; Hosseini, Resnik, and Holmes 2023).[1] With a few exceptions,[2]

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the scientific and scholarly community has reached a broad consensus that a) AI tools can be used in research and to assist scholars in specific tasks, such as copyediting and data analysis; b) AI tools cannot be named as authors because they cannot be held morally or legally responsible for their work; and c) the use of AI tools in research should be fully disclosed to promote transparency (COPE 2024; ICMJE 2024; Kaebnick et al. 2023). Now the debate has shifted toward working out the details of policies for disclosing the use of AI in scholarly publications (Ali et al. 2024; Mann et al. 2024; Suchikovaa and Tsybuliak 2024). However, developing workable policies may not be an easy task, because

> 1) AI tools keep evolving and it is difficult to craft policies that apply to current and future uses. Shortly after release of OpenAI's ChatGPT, we suggested policies that demanded full disclosure of all use cases of AI in scholarly publications, even in the absence of direct use of generated content (Hosseini, Rasmussen, and Resnik 2023). However, as will be discussed shortly, given the increasing prevalence of AI use and the integration of AI into other tools, not all use cases should be disclosed.

> 2) In the past two years, publishers and authoritative organizations have developed different and sometimes contradictory disclosure policies. For example, while Springer notes that AI-assisted copyediting "does not need to be declared" (2023), Taylor & Francis requires that "any use" of AI must be clearly acknowledged 2024). Furthermore, while the International Committee of Medical Journal Editors (ICMJE) recommends that " … if AI was used for writing assistance, describe this in the acknowledgment section" (ICMJE 2024), the World Association of Medical Editors (WAME) encourages authors to detail the exact prompts used, identify the version and type of employed tools, and specify the role they played in the research process (WAME 2023). As will be discussed shortly, these disparities demonstrate different priorities that may be supported by various ethical reasons for disclosure.

Accordingly, since what constitutes *ethical disclosure* is subject to change, and existing policies offer conflicting guidance, inconsistent disclosure practices probably exist and may continue to proliferate. Against this backdrop, researchers' use of AI could flout policies and undermine ethical norms such as honesty, transparency, accountability, and the overall integrity of research. Our aim in this paper is to propose boundaries between mandatory disclosure, optional disclosure and permissible non-disclosure based on ethical considerations and provide practical guidance to support researchers in their ethical use of AI. To shed some light on this issue, it is worth considering the reasons why disclosure is important from an ethical point of view.

Ethics of disclosure

Disclosing the materials, methods, and tools used in research is a key aspect of good scientific practice because it accords with norms such as honesty, accountability, transparency, openness, rigor, objectivity, reproducibility, fairness, social responsibility, stewardship (prudent use of resources), and legality (compliance with legal rules). Science's norms are standards of conduct and decision-making that are essential for producing knowledge, which is valuable for its own sake and for its practical and social applications. Scientific norms also promote cooperation and trust within the research community and between scientists and the public (Shamoo and Resnik 2022). In what follows we mention several ways in which disclosure of the use of AI tools in research accords with scientific norms.

First, disclosure of the use of AI tools helps to promote proper assignment of credit in scientific research, which is essential for fairness, honesty, and transparency in research. If an AI tool has been utilized to, for example, analyze the data or images in a publication, then AI's contribution should be acknowledged so that humans will not receive credit for what AI did. Credit should be given where it is due, but not where it is not due (Shamoo and Resnik 2022). Giving credit to an AI tool does not imply that the tool is an author; it only implies that the tool made a substantial contribution to the content of the research. To be an author, one must not only make a substantial contribution to the work but also agree to take moral and legal responsibility for the work, which current AI tools cannot do because they lack human-like consciousness and moral agency (Hosseini, Resnik, and Holmes 2023).

Second, disclosure of AI tools promotes accountability in research and scholarly publishing. Accountability, in turn, fosters social responsibility and legal compliance in research. If reviewers or readers discover a problem with a paper – for example, if it contains fabricated references or data, plagiarized text, or biased interpretations – it is important to know who is responsible for the problem so they can explain what happened, why/how it happened, and if necessary, bear the consequences (e.g., some form of punishment or reeducation). If the problem is due to improper use of an AI tool, detailed disclosure helps to identify human users responsible for the mishap or malfeasance, allowing steps to be taken to prevent this type of problem from arising in the future (Hosseini, Resnik, and Holmes 2023).

Third, disclosure of the use of AI tools is important for promoting reproducibility of results (Ball 2023). Reproducibility is important for producing objective and reliable knowledge and is supported by several norms, including carefulness, rigor, objectivity, honesty, openness, and stewardship. For example, if an AI tool was used to provide a narrative review, extract data for a systematic review of the scientific literature, analyze quantitative or

qualitative data, or generate synthetic data or images, the use of the tool should be properly disclosed and carefully described so that other researchers can reproduce the results or findings of the research (Fabiano et al. 2024). While the outcomes of some AI tools such as generative AI, are not always reproducible, this limitation does not justify non-disclosure, because disclosure can help other scientists better understand the limitations of the tool. In this sense, the rationale for disclosing the use of AI tools is similar to the rationale for disclosing the use of other types of materials, methods, and tools in scientific research, such as software used for statistical analysis, survey implementation, or processing of text or data (Shamoo and Resnik 2022).

Fourth, honest reporting of AI use facilitates the demarcation between human and machine contributions and enables researchers interested in metascience or history of science to better understand how AI is used in research and how the human-AI collaboration continues to evolve. Moreover, given the rapid evolution of AI tools, research on human-AI collaborations in knowledge production could positively affect the development of relevant and practical policies about use and disclosure of AI in research, thereby promoting honesty, openness, legality and social responsibility in research.

Fifth, disclosure of the of the use of AI tools is important for promoting the trustworthiness and the overall integrity of research (Resnik and Hosseini 2024). Disclosing when, how, and why AI tools were used foster trustworthiness by providing other researchers and the public with the information needed to better understand how these tools can contribute to research. While disclosure does not provide a window into the black box of AI, it can clarify the benefits and limitations of using AI (Zerilli, Bhatt, and Weller 2022).

We think it is important to carefully consider these different reasons for disclosing AI when developing disclosure policies because they have implications for the type of information and the level of details required for ethical disclosure. For example, if the main reason for disclosing AI use is to ensure that human authors do not receive more credit than they are due, then disclosure may not need to include many details about the AI use. If, however, the purpose of the disclosure is to promote reproducibility of data analysis, then disclosure may need to be highly detailed so that other researchers will have the information they need to reproduce the results.

Rapid AI changes necessitate evolving and practical disclosure norms

Because AI is rapidly becoming integrated into various computer applications (e.g., word processors and internet search engines) and research equipment (e.g., genome sequencers), disclosure policies must deal with a threshold issue, namely *when should disclosure be mandatory*. For example,

many internet search engines now incorporate AI into their search algorithms and provide AI-generated answers to search queries (Morris 2024). Disclosing that one has used an internet search engine with this functionality to do some background research for a paper serves no useful purpose, because this AI use will not substantially impact issues related to credit assignment, accountability, reproducibility, or trustworthiness. Additionally, disclosing the use of AI in a search engine could distract and divert the reader's attention from more important uses of AI, such as its use in drafting sections of the paper. Likewise, machines used in laboratory testing, such as automated genome sequencers, have incorporated AI into their operations to enhance efficiency and reliability (Vilhekar and Rawekar 2024). As long as the use of genome sequencing machine is disclosed, highlighting that the machine also uses AI does not seem to serve a useful purpose because the AI use is incidental and non-substantial.

With preceding points in mind, we argue that for disclosure to serve a useful purpose, the *AI use must be intentional and substantial*. What do we mean by "intentional and substantial?" The term "intentional" is generally well-understood by scientists and the public. To do something intentionally is to do it with a purpose or goal in mind. AI use in research is intentional when one purposefully employs a unique AI tool to conduct a specific task. However, "substantial" is a vague term that requires further specification.[3] One need looking no further than journal authorship policies to see why this is the case. Most authorship guidelines require that authors have made a "substantial" or "significant" contribution to the research (ICMJE 2024); Resnik et al. 2016), but authorship disputes are still common in academia because researchers often disagree about what counts as a substantial or significant contribution (E. Smith et al. 2020).

To make some headway on this problem, we will define "substantial" more clearly, provide criteria for identifying substantial uses of AI in research and offer some examples of such uses. In our view, AI use is substantial to the extent that it 1) produces evidence, analysis, or discussion that supports or elaborates on the conclusions (or findings) of a study; or 2) directly affects the content of the research or publication. Prior to prevalent use of AI tools, the scientific community had some generally accepted ideas about what types of contributions to a research project or publication might count as substantial (Shamoo and Resnik 2022). For example, there is general agreement among scientists that substantial contributions to research include such activities as formulating questions or hypotheses; designing or conducting experiments; collecting, analyzing, and interpreting data; creating figures or diagrams; and drafting or significantly revising manuscripts (Shamoo and Resnik 2022).

While this framework has functioned well (for the most part), it needs to be updated to account for the use of AI tools in research. To take steps

toward addressing this challenge, we consulted the AI Use Taxonomy published by the National Institute of Standards and Technology (Theofanos, Choong, and Jensen 2024). While some AI uses in the taxonomy are not relevant to scientific research and publication (for example, using AI for vehicular automation), several are. We suggest that the following three criteria are relevant for identifying substantial uses of AI tools in research:

(a) The AI tool makes decisions that directly affect research results. For example, using AI to extract data from articles to conduct a systematic review would be substantial and intentional because data extraction decisions affect the outcomes of the review.
(b) The AI tool generates or synthesizes content, data or images. For example, using AI to write sections of a paper, integrate notes or other pieces of information, translate language in the paper, or create images or synthetic data would be substantial and intentional because AI has generated or synthesized new content that directly affect research outcomes.
(c) The AI tool analyzes content, data or images. For example, using AI to analyze genomic data, text, or radiologic images would be both substantial and intentional because it produces analyses that supports findings and conclusions and affects the content of a publication.

While this is an initial list that is subject to revision as the uses of AI in research and writing evolve, at this point, we believe that disclosure of AI use should be mandatory when it meets *at least one* of these criteria. However, as we have already discussed, there are numerous uses of AI that do not meet *any* of these criteria, so it is unclear whether disclosure in such cases would serve any useful purpose. For example, using AI to copyedit a paper for grammar, suggest synonyms or improve existing phrases, need not be disclosed because the tool does not affect the overall results; it simply edits or otherwise improves expressions provided by humans.

Even so, some authors still might want to disclose AI use to avert questions about the integrity of their research that could arise if they do not disclose AI use and someone else discovers it later. Or some journal editors might prefer to have specific use cases disclosed (more on this in the discussion section under *Disciplinary nuances*). How should policies address this problem? We suggest that policies should distinguish between three situations: disclosure is mandatory; disclosure is optional; and disclosure is unnecessary. In Table 1 we provide some examples for each disclosure category based on existing use cases reported in Resnik and Hosseini (2024) and Hosseini et al. (2025). Specifically, the third option "to not disclose" may seem counterintuitive because generally, disclosure is considered as morally desirable – the more the better. However, we believe that

Table 1. Disclosing AI use in research and writing.

Disclosure is mandatory when, for example, using AI

- To formulate questions or hypotheses, design and conduct experiments.
- To draft parts of the paper, summarize, paraphrase, significantly revise or synthesize textual content.
- To translate parts or the whole paper.
- To collect, analyze, interpret or visualize data (quantitative or qualitative).
- To extract data for review of the literature (systematic or not) and identify knowledge gaps.
- To generate synthetic data and images reported in the paper or used in research.

Disclosure is optional when, for example, using AI

- To edit existing text for grammar, spelling or organization.
- To find references or verify the relevance of human-found references.
- To find and generate examples for existing content.
- To brainstorm and offer suggestions for the organization of a paper or the title of a paper/section.
- To validate and/or offer feedback on existing ideas, text and code.

Disclosure is unnecessary when, for example, using AI

- To suggest words or phrases that enhance clarity/readability of an existing sentence.
- In part of a larger operation where AI is not generating or synthesizing content or making research decisions; for example, when AI is integrated into other systems/machines.
- As a digital assistant, for example, to help organize and maintain a project's digital assets and workflows.

trivial disclosures (e.g., "I used AI to find an example") can be distracting and may mislead the reader when they are numerous (e.g., when there are 25 trivial uses, the one significant use does not stand out). Also, trivial disclosures may ultimately deter disclosure because they are burdensome.

Discussion and conclusion

Where to disclose and what to include?

Other important questions that disclosure policies should address include *where* disclosures should occur, and *what* type of information should be disclosed. As discussed in a previous publication (Hosseini, Resnik, and Holmes 2023), AI use should be disclosed in the main text of the paper (e.g., in the introduction or methods section to describe how it was used), among the references (to improve indexing and findability) and in supplementary materials or appendices (to share used prompts or screenshots). Some journals have started a new dedicated section for AI disclosures. For example, *Heliyon*, a Cell Press journal states the following in their guide for authors:

> The use of generative AI and AI-assisted technologies in scientific writing must be declared by adding a statement at the end of the manuscript when the paper is first

> submitted. The statement will appear in the published work and should be placed in a new section before the references list. An example:
>
> - Title of new section: Declaration of generative AI and AI-assisted technologies in the writing process.
> - Statement: During the preparation of this work the author(s) used [NAME TOOL/SERVICE] in order to [REASON]. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the published article.
>
> The declaration does not apply to the use of basic tools, such as tools used to check grammar, spelling and references. If you have nothing to disclose, you do not need to add a statement.
>
> (Heliyon n.d.)

We believe that this is good practice that enhances the findability of disclosure statements and can potentially result in more standardized disclosures. However, disclosure in the acknowledgments section is not encouraged because this section has been traditionally used to acknowledge human contributors who do not meet the criteria for authorship (Hosseini and Lewis 2020). Here too, we see inconsistencies between ICMJE and WAME. While ICMJE suggests that AI use for data analysis should be disclosed in the methods section, WAME recommends disclosure in "both the Abstract and the Methods section." These differences can make it difficult for the research community to know exactly how to comply and where to disclose their use of AI, leading to varied and potentially inadequate disclosures depending on what is considered as the gold standard. This may become a particularly challenging issue when navigating (re)submissions to journals that endorse WAME or ICMJE recommendations. Adapting to these varied levels of transparency underscores the complexity of complying with evolving and sometimes conflicting editorial policies on AI use and disclosure, emphasizing the need to harmonize disclosure policies.

The place of disclosure and type of information needed to satisfy policies depend, in part, on the purposes of the disclosure and the best practices within a research domain. For example, if the purpose of disclosure is to allow other researchers to reproduce a systematic review of the literature conducted by AI, then extensive details related to the methodology of the review may need to be disclosed, including the databases searched, the search terms, rules for determining the relevance of publications, and so on (Fabiano et al. 2024). Furthermore, if the purpose of disclosing the use of AI for data analysis in a manuscript's abstract (as WAME suggests) is to ensure more accurate indexing of AI use, accurate in-text citation and referencing of AI tools can achieve the same objective.

Disciplinary nuances

In some contexts, disclosure might require unique considerations. For instance, in domains where the originality of a publication is determined through the uniqueness of written expressions, journal editors might have different preferences regarding the use and disclosure of AI for the purpose of text improvement. It is for this reason that we suggested the disclosure of AI use "To edit writing for grammar, spelling, organization, or clarity" be optional – because this is context-specific. The same can be said about using AI to generate hypothetical cases for discussion, counter examples, or thought experiments. In domains like philosophy or theoretical physics, a counter example or thought experiment could be extremely valuable for supporting or critiquing arguments. Again, for this reason, we suggested that disclosing the use of AI to generate examples should be optional. On that basis, a worthwhile avenue for future research would be to survey journal editors and experts from different scholarly domains to better understand their views about the feasibility and merits of different disclosure policies.

Visibility of disclosure statements to peer reviewers

We believe that in instances where disclosures are deemed optional (e.g., to edit writing for grammar, spelling, organization, or clarity), revealing AI use to peer reviewers could contribute to biases and compromise the integrity of the peer review process. Accordingly, if authors have disclosed their use of AI (and the disclosure is optional or not necessary), this should be kept from the reviewers to minimize the likelihood of biased assessments of manuscripts. This is especially a valid concern because of reported biases against non-native English authors in the peer review system (Amano et al. 2023; Hadan et al. 2024; O. M. Smith et al. 2023). Disclosing AI use could prompt reviewers that author(s) were working/writing in a second language and inadvertently affect how their work is assessed. It should also be noted that there is precedent for non-disclosure of certain information to peer-reviewers, such as details about funding or conflicting interests. However, we recognize that non-disclosure of AI use to reviewers may also pose problems, since a reviewer who strongly suspects that AI was used to edit or organize a paper but does not see that this use was disclosed, may be biased against the paper. Thus, this topic bears further study. It might be useful, for example, to survey scientists and editors concerning their opinions on this issue.

Keep calm and let your position evolve

In closing, we would like to note that the use of AI in research continues to evolve in response to advancements in this technology. In only a few short years, the debate has evolved from whether AI tools should be used in research and writing, to how they should be used and disclosed. These shifts have rightly affected policies. For example, 2023 was the first time when the ICMJE mentioned generative AI and suggested "Authors who use such technology should describe, in both the cover letter and the submitted work, how they used it" (ICMJE 2023). In their 2024 recommendations, the ICMJE further clarified this position by adding examples "For example, if AI was used for writing assistance, describe this in the acknowledgment section. If AI was used for data collection, analysis, or figure generation, authors should describe this use in the methods." WAME's reaction to generative AI has also evolved. Their January 2023 (Version 1) recommendations (Zielinski, Winker, Aggarwal, Ferris, Heinemann, Lapeña Florencio, Pai, Ing, and Citrome 2023a) were followed by another one (Version 2) published in May 2023 (Zielinski, Winker, Aggarwal, Ferris, Heinemann, Lapeña Florencio, Pai, Ing, Citrome, Murad, et al. 2023b). Version 1 broadly encouraged authors to acknowledge generative AI use and provide necessary details, but Version 2 required authors to mention the used prompts, identify the version and type of AI tool employed, and specify the role it played in the research process. Among journals, *Science* is an interesting example. Between January and November 2023, the journal of *Science* transitioned from outright banning the use of generative AI (Thorp 2023), to allowing its use for "the writing or presentation of the manuscript" if there is full disclosure (Thorp and Vinson 2023). As mentioned in the introduction, we have changed our position from disclose all use cases, to the current position of *disclose some but not all use cases*. We see this as a healthy attitude toward a moving target. It is important, therefore, to be aware of technological changes, stay abreast of emerging ethical issues, and update guidance appropriately.

Notes

1. We realize that AI is a broad term that includes many types of machines that can learn from data. In this commentary, we are primarily focused on systems that use machine learning.
2. Some authors still argue that AIs can be named as authors (Abernethy 2024; Jenkins and Lin 2023).
3. Mann et al. (2024) define what is meant for a human to make a substantial contribution when AI is used, but they do not clarify what is meant for an AI tool to make a substantial contribution.

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Author contributions

Both authors conceived of the research and drafted and edited the manuscript.

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