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On the cover: The cover of this issue of *Science Editor* is an illustration by Rick Guidice of a fictional toroidal (doughnut-shaped) space colony commissioned by NASA's Ames Research Center in 1975. Images such as this always seem bittersweet: On one hand, they depict a future where humans have come together to persist and expand into space; on the other hand, the circumstances back on Earth that have led us to this moment where this space colony is needed are likely dire.

Credit: NASA/Ames Research Center/Rick Guidice (Image # AC75-1086-1); May 27, 1975. <https://www.flickr.com/photos/nasacommons/13889485757/> [Public Domain]



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Bridging Tradition and Technology: Expert Insights on the Future of Innovation in Peer Review

Muhammad Sarwar, Maria Machado, Jeffrey Robens, Gareth Dyke, and Maryam Sayab

Abstract

Innovation and technology are transforming peer review, with artificial intelligence (AI) and automation streamlining tasks, such as plagiarism detection, reviewer selection, formatting, and statistical checking, and significantly boosting efficiency. Yet, concerns around bias, data security, and the potential reduction in human oversight remain central. Additionally, open and virtual peer review practices have been examined for their role in promoting transparency, though they introduce challenges like depersonalization, which can reduce the human element in the review process. Overall, the discussions in this article emphasize the importance of balancing technological advancements with human expertise to uphold fairness and quality in peer review.

Introduction

The Asian Council of Science Editors (ACSE) hosted an exclusive interview series featuring industry experts who shared insights, ideas, and perspectives on the technology transforming the peer review process (Figure). The discussions highlighted critical areas, such as AI-driven

automation and open peer review, along with the challenges and opportunities these innovations bring to academic publishing.

Open Peer Review: Transparency or Compromise?

A strong advocacy for open peer review, in terms of reviewer identity and comment openness, has been maintained, particularly as this mode of peer review has been widely practiced in the field for more than 20 years. However, it is less frequently accepted or utilized (negatively correlated), with the impact factor of the journal in question, as well as with the stage of the researcher's (peer reviewer's) career. Although reviewers are generally receptive to the idea of publishing their comments openly and with their names included alongside the articles they reviewed, there is a common reluctance to share feedback if their recommendation for an article is not accepted.¹⁻³

An example of what likely is a common experience for early-career researchers can be found at Nature Communications, which has an open peer review process where reviewers can sign their reviews. A reviewer was invited to review an article authored by a senior colleague in the field based in the United States; someone with whom it was important to maintain a positive relationship. However, the quality of the paper was not particularly strong, raising a dilemma. Should participation in an open peer review process be accepted, potentially jeopardizing the relationship with this colleague? Ultimately, a compromise was made and the reviewer decided to opt out.^{4,5}

How can journals and publishers manage these competing interests: the need to be open and transparent with peer review and therefore potentially speed up the process (e.g., article transfers/cascades between journals) and make it more ethical and compliant with ever-increasing standards in research ethics, while at the same time, balancing the needs of researchers (e.g., maintain reputations, relationships,

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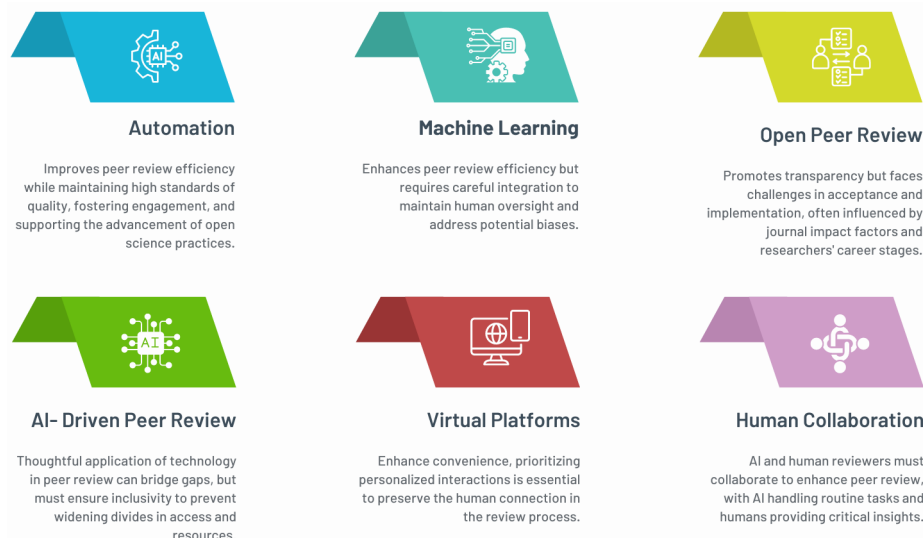


Figure. Expert perspectives on balancing innovation and integrity in peer review.

etc.)? At present, there seems to be no universal solution. The pressure remains on researchers globally to publish in journals with the highest possible impact factors,⁶ and until this “model for recognition” changes, the widespread adoption of open peer review is likely to remain limited to the lower-tier journals and/or “mega-journals” or on preprint platforms.

Automation in Peer Review: Enhancing Efficiency or Risking Quality?

AI can help increase reproducibility, automate literature collection and analysis for systematic and umbrella reviews, and provide new analysis of existing data geared toward policy developments.⁷⁻⁹ These capabilities improve efficiency and contribute to policy development by providing fresh insights from existing data. Researchers acknowledge these advantages in their work. Thus, improving the review process through AI could make the activity faster and more enjoyable.

Automated scoring using text recognition would help diminish the volume of low-quality research that progresses through to peer review.^{1,10-12} This would enhance the overall quality of published work, as only the most rigorously vetted studies would reach publication. Linking reviews with reputation and career advancement will have the most significant impact on motivation. Providing reviewers with learning opportunities, recognition, and certification will undoubtedly increase their engagement and willingness to take on this kind of work. Moreover, mentorship programs could further ensure that the skills gained through peer review are transferable to other professional roles that academics often assume. This would benefit everyone, as continued engagement would enable reviewers to focus on critical analysis and creative insights.

Looking ahead, making peer review more equitable, integrative, and accessible could demystify the process and promote the adoption of open science practices.

Machine Learning in Peer Review: Game Changer or Double-Edged Sword?

Machine learning (ML) is a subfield of AI that uses algorithms trained on data to produce adaptable models capable of performing various complex tasks. ML has the potential to enhance efficiency by streamlining editorial triage and identifying appropriate reviewers, potentially increasing diversity and reducing reviewer fatigue.¹⁰ Additionally, it alleviates mundane tasks, minimizing human biases in reviewing specific research topics or institutions.¹ However, despite its potential, ML has yet to reach its full capabilities. Many researchers remain cautious due to the nascent and rapidly evolving nature of the technology. Despite its potential, integrating ML into peer review carries risks. Key concerns include biased training data, which may inadvertently favor widely held ideas and specific regions that publish more frequently. Furthermore, reviewers bring valuable context from their experiences, including failed experiments and grant rejections, that ML might overlook. Worries also persist about the accuracy of AI-generated outputs and potential data privacy issues, particularly with sensitive unpublished work. Environmental concerns related to AI's energy and water consumption raise questions, especially for publishers committed to sustainability goals.

Researchers are increasingly open to ML but remain wary of losing the human element in evaluations. While ML tools can combat reviewer fatigue and allow human reviewers to focus more on scientific merits, they risk oversimplifying complex assessments.¹⁰ To balance these benefits with risks,

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the industry needs clear, transparent, and standardized guidelines for AI use, coupled with robust data security measures and independent validation of ML models. The theme of innovation and technology in peer review highlights the urgency of finding new models to address current challenges. By leveraging ML, we can work toward a more efficient, transparent system, ensuring that reviewers continue to focus on the core task of evaluating science.

AI-Driven Peer Review: Objectivity or Bias?

AI-driven peer review offers both advantages and challenges when it comes to objectivity. On the positive side, AI can efficiently analyze submissions, detect plagiarism, and help select suitable reviewers, streamlining the process. However, its ability to be truly objective depends on the quality of the data used to train it. If that data is biased, the AI may unintentionally reinforce those biases.^{7,8} This can lead to underrepresenting certain regions or research topics.

To avoid these issues, human oversight is essential. Although AI can handle repetitive tasks, it cannot replace human reviewers' critical thinking and judgment. Rigorous auditing of AI systems and databases is crucial to ensure fairness in the review process. Though AI has the potential to improve objectivity, the key is using it responsibly, ensuring that humans remain involved to balance the strengths and weaknesses.

Technology in Peer Review: Bridging Gaps or Widening Divides?

Technology has undoubtedly changed peer review, but whether it bridges gaps or creates new ones depends on its application. AI can improve efficiency by matching manuscripts with appropriate reviewers and flagging issues like conflicts of interest. This can significantly reduce the time it takes to complete peer reviews, ensuring a more efficient process for both authors and reviewers. When applied thoughtfully, these advancements can bridge gaps by creating a smoother and more standardized review process.

However, there is also the risk that researchers from more resource-limited areas could be left behind¹³ because they might not have access to the necessary tools and infrastructure. Access to reliable internet and advanced tools can be limited in resource-constrained settings, creating disparities. To ensure fairness, platforms must be designed to accommodate different regions and expertise levels, fostering inclusivity and global collaboration in the academic community.

Virtual Peer Review Platforms: Convenience or Complexity?

Virtual peer review platforms are online systems that facilitate the peer review process, allowing reviewers, editors, and

authors to interact, submit, and evaluate manuscripts in a digital environment. In their 2 decades of use, virtual peer review platforms have certainly brought convenience to the review process, offering benefits like global accessibility, streamlined workflows, and faster submissions. However, as these platforms have expanded and grown, they have introduced new challenges. For example, one main concern is the potential depersonalization of the review process as interactions become more automated and less personal. Reviewers often face fatigue because of the overwhelming number of requests through these platforms.¹⁰ To maintain the human connection, it is essential to encourage personalized feedback and create open peer review systems in which authors and reviewers can collaborate more closely.

Although virtual platforms have made it easier to handle a large volume of manuscripts, they also create a steep learning curve for reviewers and editors transitioning from traditional methods. The impersonal nature of automated notifications can make it difficult for reviewers to feel connected to the work. Despite these complexities, technology, including AI, has improved the efficiency of tasks such as plagiarism detection and reviewer selection. Moving forward, incorporating innovations like interactive manuscript formats and better incentives for reviewers could help address some of these challenges by balancing convenience with a more personal, human approach to peer review.

Human-AI Collaboration in Peer Review: A Partnership or a Power Struggle?

Integrating AI into peer review has sparked debate over whether it should be viewed as a partnership or a power struggle. AI can handle routine tasks like plagiarism detection, statistical checks, and manuscript screening, which allows human reviewers to focus on more complex evaluations, such as ethical considerations and the research's broader context.¹ When AI complements human expertise, it enhances the efficiency and quality of peer review without threatening human judgment.

Still, achieving this balance requires careful implementation. Human reviewers bring irreplaceable insights, especially in areas like ethics, critical thinking, and understanding subtle research nuances. Whereas AI can assist in repetitive tasks, human oversight remains essential to ensure the technology is used responsibly. The future of peer review will likely involve deeper collaboration between AI and humans, where AI supports reviewers without replacing their crucial role in maintaining the integrity and quality of the peer review process.

Conclusion

The growing role of AI and technology enhances the peer review process, offering efficiency improvements through tools

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like automated plagiarism detection and reviewer selection. However, concerns about bias, data security, and the potential loss of the human element remain significant. Experts stress the need for human oversight, as AI cannot replace human reviewers' critical thinking and ethical judgment. Open peer review and virtual platforms are acknowledged for their transparency but present challenges such as depersonalization and the risks to professional relationships. While these innovations offer benefits, their widespread adoption, particularly in high-impact journals, could be hindered by reputation and career advancement concerns.

The key takeaway is that the future of peer review requires a balanced approach, integrating AI with human expertise. Transparent guidelines, responsible AI use, and a focus on inclusivity will be essential for building a more equitable, efficient, and reliable peer review system.

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Diversification and Decentralization of Peer Review: Part 1—Initiatives at the Forefront

Tony Alves

The traditional peer review system, long regarded as the cornerstone of scholarly publishing, is facing growing scrutiny due to inefficiencies, biases, and barriers to inclusivity. In response, a wave of innovation is reshaping research evaluation through the diversification and decentralization of peer review. This article explores emerging models—including preprint servers, overlay journals, and postpublication forums—that enhance transparency, broaden reviewer participation, and streamline the publication process. By leveraging technology and community-driven initiatives, these new approaches aim to create a more equitable and efficient scholarly ecosystem, ultimately strengthening the integrity and accessibility of research.

Peer review is often regarded as the bedrock of scientific quality control, ensuring that only rigorously vetted research reaches the public sphere. Tracing its origins back to *Philosophical Transactions of the Royal Society* in 1665, it has remained a cornerstone of scholarly publishing. However, the system as it stands today is overburdened, slow, opaque, and susceptible to bias—leading to growing calls for reform.

At its core, peer review is an iterative process where experts assess the work of their peers, ideally improving research quality. Traditionally, it follows a structured model: An author submits a manuscript to a journal, the editor assigns anonymous reviewers, and their feedback informs the decision to publish, revise, or reject. While this system has served its purpose for centuries, its inefficiencies have become more pronounced in recent years.

One major criticism is the slow pace of the process. It can take months—or even years—for a manuscript to navigate through rounds of review, revision, and eventual publication. This delay is especially problematic in fast-moving fields like biomedicine and climate science, where timely dissemination of research is crucial.

Opacity is another challenge. Traditional peer review occurs behind closed doors, with authors often receiving limited insight into the decision-making process. This lack of transparency can lead to frustration and, in some cases, the perpetuation of errors or flawed research.

Bias also remains a significant concern. Studies show that factors such as an author's gender, nationality, or institutional affiliation can influence review outcomes. Women and scholars from underrepresented regions are disproportionately disadvantaged, while the anonymity of reviewers can sometimes enable harsh or unfair assessments without accountability. Additionally, an overreliance on traditional metrics like Impact Factor and citation counts can reinforce systemic inequities in research evaluation.

Another pressing issue is the increasing burden on a small pool of reviewers. With the volume of submitted research continually growing, finding qualified reviewers has become more difficult. Overworked reviewers may provide rushed or superficial feedback, undermining the integrity of the process.

In response to these challenges, a movement toward decentralized and community-driven peer review is emerging (Figure). Leveraging technology and new platforms, alternative models aim to diversify participation, enhance transparency, and make research evaluation more efficient.

Decentralization allows feedback from a broader pool of reviewers, including early-career researchers and those traditionally excluded from the process. By shifting research evaluation into a more public space—such as preprint servers and open peer review platforms—these models foster greater accountability and collaboration. They also highlight previously overlooked values in research assessment, enabling more nuanced and inclusive evaluation criteria.

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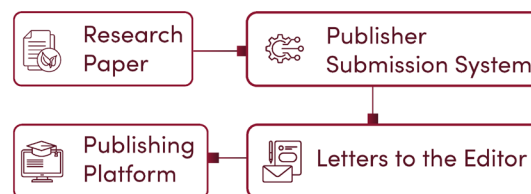
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Traditional Peer Review

- A research article can be seen as a conversation between scholars, and in the past this conversation took place almost exclusively between **privileged colleagues**
- More recently, part of the **anonymous peer review process**



Community Peer Review

- Today technology allows this conversation to take place in the open, by independent review services sometimes called “**community peer review**”
- The conversation is ongoing; preprint reviews travel along with the manuscript, appearing on preprint servers, overlay journals, and traditional journals, integrated into the peer review process
- **Post-publication**, the article can be discussed on the journal’s website or by independent journal clubs

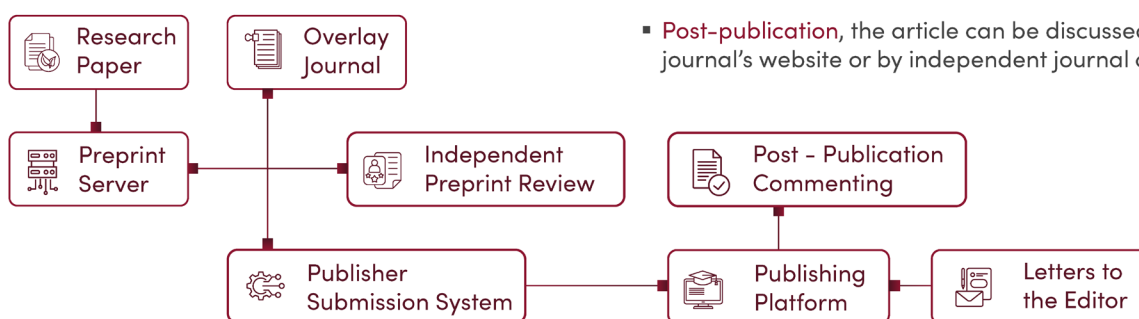


Figure. Traditional peer review is often a closed system, taking place among privileged colleagues. Community peer review expands the opportunities for gathering feedback throughout the publishing lifecycle.

Ultimately, reimagining peer review offers the potential to address long-standing inefficiencies while preserving its essential role in scientific validation. As scholarly publishing evolves, embracing more open, transparent, and diverse review systems may lead to a more equitable and effective research ecosystem.

Preprint Servers: Disrupting Scholarly Publishing

Preprint servers are transforming the landscape of scholarly publishing by offering a more open and immediate form of research dissemination. A preprint, sometimes referred to as a “working paper,” is a version of a research article that is shared publicly before it has undergone formal peer review. The primary purpose of preprints is to allow researchers to share their findings with the world as early as possible, gaining feedback from a much wider audience than the traditional journal-based system permits, as has been illustrated in the previous section on independent peer review providers. This form of early dissemination has been especially useful in fast-moving fields like biomedicine, physics, and climate science, where the timely exchange of information can significantly impact ongoing research and decision-making.

Unlike traditionally published articles, preprints are posted, not published. This distinction is important because preprints are not yet formally endorsed by a journal; they are works in progress. However, preprints still hold significant value. By posting to a preprint server, researchers can disseminate their findings to the global community, inviting comments and feedback from anyone who comes across the paper. This process is more formalized than the traditional practice of sending manuscripts to a few colleagues for informal feedback, but it still lacks the finality of a journal version of record.

Preprints are also changing the way journals interact with researchers. Most major journals now allow authors to submit articles that have already been posted on a preprint server, a shift from the earlier practice where preprint sharing could disqualify a paper from submission. In fact, some journals now actively encourage authors to upload their work to preprint servers, while others offer to post submitted articles on a preprint server for authors. This approach allows research to be shared more widely and evaluated in parallel with journal submission, a model illustrated in one of the use cases below.

(Read the rest of this article online at <https://doi.org/10.36591/SE-4801-14>.)

Diversification and Decentralization of Peer Review: Part 2—Tools That Facilitate

Tony Alves

Part 1 explored the innovations that are reshaping the peer review process, including community and third-party services that are expanding the reviewer pool, as well as preprint servers, overlay journals, and postpublication forums that serve as examples of a more open and transparent ecosystem. Part 2 highlights the technology initiatives that streamline processes and enable experimentation in peer review. These technologies, including communication protocols, messaging services, embedded XML, and persistent identifiers, provide the necessary digital infrastructure. Also included are four key use cases that illustrate how decentralized peer review is an effective and innovative contributor to the scholarly publishing ecosystem. Each use case highlights the potential benefits of these new models, including increased transparency, faster turnaround times, and greater inclusivity. By integrating community-driven platforms, open protocols, and diversity-focused initiatives, these use cases provide a blueprint for the future of peer review.

Technology and System-to-System Communication Protocols in Peer Review: Enhancing Efficiency and Transparency

The digital era has reshaped scholarly publishing, and system-to-system communication protocols have become integral to modern peer review workflows. These protocols enable seamless data exchange between research platforms, preprint servers, journals, and peer review services, allowing reviews and research metadata to follow manuscripts across various stages of publication. This ensures peer review processes are portable, efficient, and

accessible. Key technologies facilitating these exchanges include Manuscript Exchange Common Approach (MECA), Confederation of Open Access Repositories (COAR) Notify, and DocMaps, all of which promote interoperability in scholarly communication.

MECA

MECA, a NISO Recommended Practice, streamlines the transfer of research manuscripts between systems. MECA is a standardized protocol that defines how to package and transfer manuscript files and associated metadata from one system to another. Whether a manuscript is being moved between preprint servers and journals, or across different submission systems, MECA ensures that all relevant data travels with the manuscript, reducing redundancies and the need for re-entering information.

One of MECA's primary uses is to facilitate cascading workflows, where manuscripts move seamlessly between different stages of submission and review. MECA supports 3 primary use cases:

1. **Submission System to Submission System.** This enables cross-publisher transfers, allowing manuscripts to move easily from one journal to another, while maintaining the full peer review history.
2. **Preprint System to/from Submission System.** MECA supports the transfer of manuscripts from preprint servers to formal submission systems, addressing the growing popularity of pre-review distribution on platforms like bioRxiv and arXiv.
3. **Authoring System to Submission System.** By simplifying the connection between authoring platforms and journals, MECA helps authors quickly submit their work to the preprint server or journal of their choice.

MECA is built around the key principles of minimizing repeated data entry and maintaining interoperability. It promotes consistency and reliability in manuscript exchanges, eliminating redundant efforts and making the entire submission and review process faster and more

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convenient. For more details about MECA, visit the official NISO MECA webpage.¹

COAR Notify: Connecting Repositories to External Services

COAR Notify, developed by COAR, is an initiative that supports the seamless integration of research outputs hosted in repositories and preprint servers with external services, such as overlay journals and peer review platforms. COAR Notify provides a decentralized, interoperable system that allows research outputs like preprints to be linked with peer review services and journals, ensuring that data travels efficiently between different platforms.

The primary aim of COAR Notify is to reduce the technological barriers between systems, enabling repositories and review services to participate in the evolving publish, review, curate model for scholarly communication. Some key use cases include:

- Allowing authors to request peer reviews directly from a repository when they deposit a preprint.
- Enabling authors to request publication by an overlay journal that sits on top of a repository.
- Linking datasets from one repository to articles housed in another, promoting more cohesive research networks.

COAR Notify's interoperability is essential for developing community-led peer review platforms. Like Peer Community In (PCI) and PRereview, allowing them to scale and engage with the broader publishing ecosystem. By putting these connections in place, COAR Notify helps bridge the gap between repositories and review services, making peer reviewed preprints more accessible. You can learn more about COAR Notify here.²

DocMaps: A Breadcrumb Trail for Research Evaluation

Developed by MIT's Knowledge Futures Group, DocMaps offers a framework for creating machine-readable documentation of the editorial and peer review processes that research manuscripts undergo. DocMaps provides a structured way to capture the editorial journey of a manuscript, including key details such as peer reviews, editorial decisions, and revisions. This metadata can then be embedded into the document, allowing other systems to interpret and use it.

The concept behind DocMaps is akin to leaving a breadcrumb trail for research, documenting every step of the peer review and editorial processes. The system can record details like:

- When and where a manuscript was submitted
- What quality check tools were administered

- Which reviewers were involved and their feedback
- Revisions requested and subsequent responses from the authors

DocMaps ensures this information is machine-readable, meaning that other platforms—such as indexing services, repositories, or funders—can extract the data to analyze the quality and transparency of the peer review process. By documenting the editorial path of research in a standardized format, DocMaps promotes greater transparency and accountability in scholarly publishing. This benefits not only readers but also funders and institutions looking to assess the rigor of the peer review process. For more information on DocMaps, visit DocMaps Knowledge Futures.³

Persistent Identifiers: Building Trust and Integrity in Research

Alongside these system-to-system protocols, the use of persistent identifiers (PIDs) is crucial for ensuring interoperability as well as the trustworthiness and integrity of research workflows. PIDs are standardized unique identifiers assigned to individuals, institutions, and research outputs, allowing them to be tracked and referenced across different platforms. In the context of peer review, PIDs are essential for ensuring that data can be accurately linked and verified, ensuring trust among authors, reviewers, and readers.

Here are some of the most important PIDs used in scholarly publishing:

- **ORCID.** ORCID (Open Researcher and Contributor ID) provides a unique, persistent identifier for individual researchers, allowing their work to be easily linked across platforms. ORCID helps to disambiguate authors with similar names and ensures that contributions to research—whether authorship, review, or editing—are correctly attributed. ORCID is particularly important in peer review, where it can be used to verify the identities of reviewers and ensure the integrity of the review process. For more information on ORCID, visit [ORCID.org](https://orcid.org).
- **ROR.** ROR (Research Organization Registry) is a persistent identifier for research organizations, including funding organizations, ensuring that institutional affiliations are correctly attributed in research outputs. ROR helps to track the contributions of institutions to research and ensures that organizational data remains consistent, even in cases of name changes or mergers. It allows research outputs to be accurately connected to the institutions that supported them. You can explore more about ROR at [ROR.org](https://ror.org).

(Read the rest of this article online at <https://doi.org/10.36591/SE-4801-15>.)

When Declarations Just Don't Cut it: Building a Risk-Based Framework for AI Guidelines in Publishing

Avi Staiman

Artificial intelligence (AI) is no longer a peripheral tool in the scientific process; it is rapidly becoming central not only to manuscript preparation, such as writing, editing, and revisions, but also to the core components of research itself, including literature review, data processing and analysis, and identifying significant outcomes. Now that the discussion around the rise of these tools has been covered ad nauseam, the focus must now shift to addressing its risks and opportunities with clear, actionable strategies.

Publishers are confronted with a growing need for a robust framework to assess and manage the risks and opportunities associated with AI tools. This article focuses on 4 concrete steps publishers can take to develop and implement an effective risk and opportunity management strategy for AI adoption, and offers clear recommendations for policy, oversight, and education.

Addressing the Risks in High Res: Building a Risk Management Framework

When the European Union (EU) created its policy on AI, it did not suffice with a one-size-fits-all approach. Rather, the EU AI Act¹ established a risk register framework through which new tools and use cases could be reviewed, evaluated, and

categorized. The potential risk and harm of these tools are carefully scrutinized, with subsequent reporting, compliance, and regulatory demands imposed in line with the respective profile of respective tools. For example, personal surveillance requires a much higher degree of compliance and oversight than personalized AI restaurant suggestions. The European Commission has taken those guidelines and adopted them into high-level living guidelines for AI in research.²

Unfortunately, scholarly publishing has yet to introduce the same level of granularity³ and clarity into its policy guidelines, sufficing for a generic "declaration" requirement, regardless of the nature, use, and risk the tool presents. As a result, many researchers either do not understand what is being asked of them or simply choose to ignore publisher "declaration" requirements altogether.⁴

The integration of AI tools into scientific publishing demands a structured and actionable risk-management framework. Moving beyond vague declarations and reactionary prohibitive policies, publishers must adopt a systematic approach that evaluates AI tools based on their specific functions, applications, and risk levels. Following are 4 suggestions for how to go about doing so:

1. Developing a Risk Profile for AI Tools

The first step is for the industry to establish a **risk profile for AI tools**. Not all AI applications pose the same level of risk, and treating them as a monolith oversimplifies the complexities involved. For example, language editing tools that refine grammar and style carry lower risks than tools used to generate research content or evaluate manuscript integrity. Publishers can categorize AI tools based on their core functionalities—language support, data analysis, manuscript screening, or peer review—and assign risk levels accordingly. For example, a grammar correction tool might be categorized as "low-risk," whereas an AI tool capable of running data analysis might fall under "high-risk."

Avi Staiman is the founder and CEO of Academic Language Experts. A full biography is available in the online version of this article.

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2. Maintain a List of Approved Tools

In addition to profiling tools, publishers in similar areas should get together to develop a **list of approved AI tools**, vetted for reliability, transparency, and compliance with ethical standards. This approved list should be dynamic, updated regularly based on performance reviews, and made accessible to editors, authors, and reviewers. Clear communication of these approved tools will reduce uncertainty and create consistency across editorial processes. This publisher consortium could collaborate with organizations such as Ithika S&R that are maintaining an active Generative AI Product Tracker⁵ so they do not need to start from scratch.

3. Not All AI Use Cases Should Be Treated Equally

Another essential element mentioned in the EU's guidelines for AI in research is the **differentiation between substantive and nonsubstantive uses of AI**. Substantive uses—such as generating content, analyzing results, or drafting research conclusions—carry higher risks compared with nonsubstantive uses, such as grammar corrections or formatting assistance. Another example of a substantive use case might involve AI generating a complete literature review, whereas a nonsubstantive use could involve formatting a manuscript according to journal guidelines. Publishers should clearly define these boundaries and outline acceptable levels of AI involvement in each category.

This distinction may also affect declarations and where they appear in the manuscript. For example, analyzing results would need to be declared in the methods section, whereas some other substantive uses may not (e.g., generating an abstract or introduction).

4. Back to the Basics of What Makes Good Science

We often relate to AI tools as the potential arbiters of science itself instead of tools to automate parts of the scientific process or increase efficiency when used by authors. **Reliability and replicability scoring systems** for submissions, regardless of whether AI tools are used or not, can provide an additional layer of oversight. Perhaps publishers should reconsider how they can evaluate submissions based on their ability to produce consistent, accurate, and reproducible results, and not whether or not AI tools were used to help them do so.

The Role of Education and Training

I have the sense that many publishers have jumped to drafting and implementing policy without their editorial

teams developing a deep understanding of different AI tools and how they work. A critical aspect of AI risk management is ensuring that editorial staff, authors, and reviewers are well-versed in both the capabilities and limitations of AI tools. Editorials, such as the one published by ACS Nano in 2023, that layout best practices for authors⁶ when using AI tools, go a long way to promote author understanding and education, before jumping straight into policy.

Education initiatives should go beyond basic training and include practical workshops and scenario-based exercises that mirror real-world publishing challenges. Editorial teams must be trained to recognize AI-generated content, assess AI tool outputs critically, while identifying potential misuse. In the AI boot camps I have run at universities and publishers around the world over the last 12 months, authors and editors focus on technical proficiency alongside ethical awareness, while gaining a deep understanding of how the tools work and the engines that power their outputs. This empowers them to make informed decisions regarding author use and how and when they should be integrating AI tools into their own workflows.

For example, one of the most common points of confusion for publishers is differentiating between purely generative large language models, such as ChatGPT, that are prone to hallucinations, and retrieval-augmented generation systems, such as Scite, Elicit, and Perplexity, that find real scientific literature.

We Will Work Together Because We Have no Other Choice

The integration of AI into scientific publishing is not a temporary experiment—it represents a structural transformation. The next phase of AI adoption will likely see more sophisticated tools entering editorial and peer review systems, bringing both promise and new challenges.

Publishers must anticipate these advancements by building flexible risk management strategies and policies that can adapt to emerging technologies. Collaboration across the industry will be critical to build shared frameworks, joint guidelines, and industry-wide initiatives that can help standardize AI policies and prevent fragmentation across publishers.

Moreover, global partnerships with technology providers, academic institutions, and regulatory bodies will play an essential role in shaping the ethical and operational foundations of AI adoption in publishing.

The conversation around AI in scientific publishing must move beyond whether to adopt AI tools and instead focus

(continued on p. 21)

Advancing PDF in Scholarly Publications

Peter Wyatt

Introduction

In the late 1990s, PDF became the digital file format of choice for scientific and technical publishers. Thanks to precise and exact typesetting of paginated content, device-independent color and vector graphics, and guaranteed results both on-screen and in print, even the first generation of PDF documents from 1993 are still fully functional today.

Unbeknownst to many, the PDF format has undergone enormous change in its 30+ years. In 2007, Adobe surrendered control over the format to an ISO committee, which has since defined PDF as ISO 32000, an open international standard developed under consensus-based processes. As a result, support for PDF is ubiquitous, with creators, viewers, and other PDF software an integral part of all browsers, platforms, and devices.

Common perceptions of PDF, however, have not significantly changed since the early 2000s, when both the file format and the most popular viewer were controlled by a single organization. Today, 17 years after PDF became an international standard, various misconceptions remain commonplace:

- **“Adobe PDF”** Though a common reference, this is a misnomer. PDF became an open international standard in 2008 and is supported today by thousands of vendors providing users with many alternatives.
- **“The notion that PDF content is never searchable or extractable.”** In the early days of PDF, file size, font licensing, the complexity of digital font technologies, and limited PDF software impacted access to PDF’s text content. Modern PDF applications that directly export PDF will always embed necessary font data as is required by the latest PDF 2.0 standard and all ISO-standardized subsets of PDF.

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Opinions expressed are those of the authors and do not necessarily reflect the opinions or policies of their employers, the Council of Science Editors, or the Editorial Board of Science Editor.

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- **“PDF is inaccessible to those who need assistive technologies (AT) in order to read and navigate documents.”** Tagged PDF,¹ the feature that enables accessible PDF,² was added to (then) Adobe PDF in 2001. The first ISO standard defining the correct use of PDF for universal accessibility—ISO 14289, PDF/UA—was first published in 2012. Unfortunately, some authoring applications still do not fully support Tagged PDF when exporting to PDF; hindering the creation of truly accessible PDFs.
- **“PDF has remained unchanged since the 1990s.”** This fallacy was reinforced by various authoring applications that, until relatively recently, only saved PDF files using legacy PDF versions with severely reduced feature sets. A global focus on accessibility, prompted by laws and regulations (e.g., the European Accessibility Act [EAA]³) requiring accessible content, triggered developers to update their office applications so authors could export richer and more accessible documents across HTML, EPUB, and PDF.
- **“Offline paginated content is outmoded.”** Standalone, single-file, paginated content remains relevant to scholarly publishers and their end users, including professors, students, librarians, researchers, and other academics, as continued demand for both PDF and EPUB demonstrate.

PDF 2.0

ISO 32000-1, published in 2008, represented an ISO-standardized version of Adobe’s PDF 1.7⁴ specification. Nine years later, in 2017, the first consensus-based, vendor-neutral open standard for PDF was published as PDF 2.0⁵ (ISO 32000-2). While maintaining backward compatibility with past versions of PDF, PDF 2.0 introduced several new file format features and requirements relevant to STEM publishers.

- All font data is now required for every PDF file. Legacy versions of PDF allowed a dependency on external fonts, which led to varying appearances and difficulties in extracting text.
- Support for the latest Unicode standard, ensuring that content in any language can be reliably represented for extraction and reuse.

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- The addition of MathML 3.0 as a “first-class citizen” in PDF’s Logical Structure feature enables full accessibility for complex mathematical typography (Figure 1).
- An updated set of semantic “tags” to improve accessibility and reuse of a wide range of content.
- A new Associated File feature, wherein embedded files of any format can be associated with any PDF object along with a semantic relationship to that content, such as the original source data (e.g., a CSV for a chart), an alternate representation, a data schema, etc.
- A vendor-neutral portable collection feature, enabling single-download distribution of multiple files (of any format) in a single PDF package. If PDF documents are contained in the collection, they may also reference (hyperlink) each other.
- Interactive 3D content can be supported via multiple 3D formats (U3D, PRC, glTF, and STEP AP242) for use in medical, engineering, and other disciplines (Figure 2).
- The addition of geospatial coordinate measurement features used in cartographic and related applications.
- Updated digital signature technology, capable of providing authenticity guarantees.
- Support for the latest, modern encryption algorithms for secured content.
- An “unencrypted wrapper” feature enabling proprietary digital rights management (DRM) with a controllable publisher-defined experience.
- XMP-based metadata is now the preferred metadata format, enabling a far richer metadata vocabulary and easier discovery.

The PDF Association⁷ continues to develop new PDF specifications, extensions, guidelines, and test suites

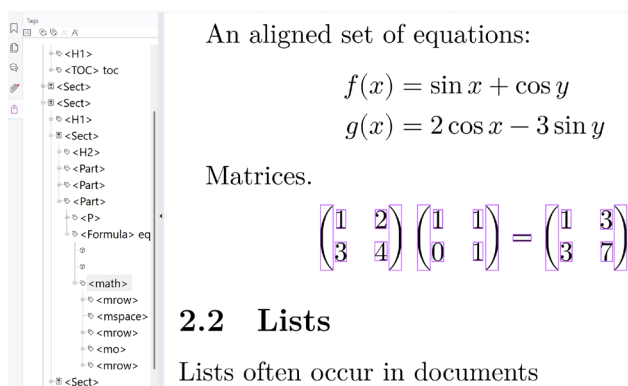


Figure 1. This example PDF file (<https://pdfa.org/download-area/examples/MathML-in-PDF.pdf>) was generated by the LaTeX Project’s WTPDF generator at <https://latex3.github.io/tagging-project/documentation/wtpdf-from-latex>, using default (as of February 12, 2025) settings.

to maximize interoperability and ensure a consistent understanding of PDF standards. For example, as of this writing, and at the request of stakeholders in the publishing industry, the organization is developing a specification for the inclusion of ONIX⁸ payloads in PDF files. The PDF Association is also working with office application suite developers to enable the export of semantically rich documents to modern PDF.

Leveraging ISO Standards for PDF in Publishing

Unlike the transient nature of the web with content and URLs that come and go, PDFs are fully self-contained documents that can persist indefinitely. Once a PDF document is added to a library, whether it be an institution or a personal library, that exact PDF remains available and usable forever under the librarian’s sole control.

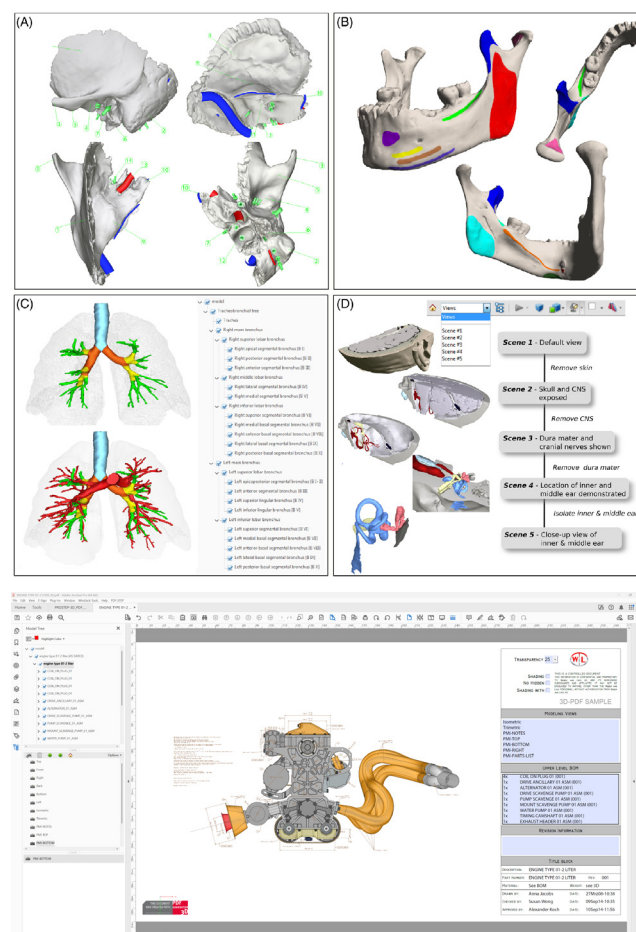


Figure 2. (top) Image reprinted from Azkue.⁶ (bottom) Screenshot from Adobe Acrobat that is supposed to represent “engineering content” (<https://pdfa.org/3d-pdf-showcase/#technical>; https://pdfa.org/wp-content/uploads/2021/12/PROSTEP-3D_PDF_TDP.pdf).

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For formal long-term preservation needs, such as those required by national archives, museums, and some libraries, a specialized profile known as PDF/A⁹ (“A” means “archival”) was first formalized as ISO 19005 in 2005. This profile is designed so that PDF files that declare conformance to PDF/A can be easily machine-validated (i.e., checked by software) upon submission or ingestion.

To support production of physical products (i.e., books, journals, and other printed materials), ISO 15930 (better known as PDF/X¹⁰ [“X” means “eXchange”]) was first standardized in 2001 for the graphics arts and commercial printing industries. PDF/X supports the blind exchange of PDF content (meaning only the PDF file is needed) with all data necessary to ensure exact and reliable printed output across disparate print providers. This permits geographically dispersed printing, reducing distribution and mailing costs while ensuring that all printed copies are identical.

The principles of web accessibility as defined in the Web Content Accessibility Guidelines (WCAG)¹¹ are applicable to web content, but WCAG’s guidance, being oriented towards web content, does not fully address PDF. To ensure that PDF documents are readable and navigable by users who must use AT, the PDF technology community developed PDF/UA^{12,13} (“UA” means “Universal Accessibility”), first formalized as ISO 14289 in 2012. Authoring applications now include accessibility checking to support WCAG, and as a result, can produce Tagged PDF as well as accessible HTML and EPUB.

PDF’s evolution from a free (but proprietary) specification to an open international standard continues to add new features and vendor-neutral capabilities, with more to come. Each significant generation of PDF is matched with updated PDF/A, PDF/X, and PDF/UA standards to ensure ongoing success for the industries that depend on these documents. Today, many other industries have built on top of these widely adopted standards to create specialized applications that leverage the general availability software that creates, validates, views, or otherwise uses PDF.

Author Guidance

As capable as modern PDF is, any given PDF document can only be as good as the way in which it was created. For example, PDF can be entirely accessible with fully extractable and reusable rich content, but only when both the document’s author and their creation software prioritize the steps necessary to produce such content. This rich content (for the eye and the printed page) can also be of archival quality as preferred by libraries. Thus, publishers are responsible for ensuring that capable authoring applications are chosen and correctly used to ensure that the author’s intended semantics are appropriately captured and can be exported to PDF, HTML, or EPUB. Simply formatting text to look like a heading will not make it a heading, using a dash or asterisk does not make

something a list, etc. Thankfully, all modern office application suites now use style sheets with accessibility suggestions supported by artificial intelligence. These applications can generate a Tagged PDF and even PDF/UA-compliant documents, while the latest updates to LaTeX¹⁴ enable PDF/A and PDF/UA generation from STEM content.

In light of the ongoing evolution of PDF, publishers should update their workflows and author guidance in several ways:

- Ensure all authors’ application templates are updated and include the necessary accessibility features and clear instructions on how to export to PDF. These application features are critical for ensuring that exported content, whether HTML or PDF, can be accessible. Instructions are important because PDFs created via print pipelines, although identical in appearance, will not contain rich features or semantics.
- Avoid legacy PDF versions by requiring PDF 1.7 and PDF 2.0 as this helps to ensure the use of up-to-date software and provides the best chance of receiving high quality semantically rich content at the smallest file size.
- Accept and publish all PDF publications as Tagged PDFs, ideally as PDF/UA (ISO 14289) compliant, to meet EAA, Section 508,¹⁵ and other regulations that support users who need assistive technology.
- For publications that include mathematics, ensure PDF 2.0 and MathML are used.
- Only accept PDF publications that include all fonts and related Unicode data. Complying with either PDF/A, PDF/UA, or PDF/X guarantees this is always achieved. Out-of-date authoring software with legacy PDF versions or creating PDFs via printing pipelines cause such issues.
- Ensure authors understand and use predefined styles wherever possible, and limit the use of inline styling, as manually applied inline styling cannot convey the same necessary semantics.
- Provide authors with PDF validation tools and training so they can check their documents prior to submission.
- Encourage the use of PDF 2.0 or PDF/A files with associated embedded files for publications supporting open data with reasonably-sized data sets. These data files can be semantically associated with specific PDF content, such as a chart or image. PDF also supports efficient data compression.
- Accept and publish PDF documents that include interactive 3D and geospatial content, as these are standardized PDF features.
- Accept and publish PDF documents with accurate document XMP metadata.

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Table. PDF as defined by ISO standards.

Technology	Nomenclature	PDF 1.7	PDF 2.0
Core PDF specification	PDF	ISO 32000-1:2008	ISO 32000-2:2020
PDF for archiving	PDF/A	ISO 19005-3:2012	ISO 19005-4:2020
PDF for universal accessibility	PDF/UA	ISO 14289-1:2014	ISO 14289-2:2024
PDF for graphic arts/printing	PDF/X	ISO 15930-8:2010	ISO 15930-9:2020

- Always refer to the PDF file format in a vendor-neutral manner. PDF is best referred to as “Portable Document Format” or simply “PDF.” If technical precision is important, reference ISO 32000. For specialized applications, other PDF nomenclature and related ISO standards might also be used, such as PDF/UA or ISO 14289 for accessibility, PDF/A or ISO 19005 for long-term preservation, or PDF/X or ISO 15930 for print publications.

These recommendations assume that publishers are themselves using modern, up-to-date PDF software in their workflows. This entails—at a minimum—full support for PDF 1.7 based on ISO 32000-1 and preferably, PDF 2.0 because the occurrence of PDF 2.0 is increasing with more and more technical authoring applications recognizing the clear benefits of new features such as those listed above. Publishers that fail to support PDF 2.0 for technical and scholarly publications in the near future face reputational risk, increased costs to their business, and potential regulatory risk.

Conclusion

PDF is a living, thriving file format developed and actively maintained in the PDF Association, a consensus-based, vendor-neutral standards organization, and formally standardized via ISO. The principal ISO standards defining PDF are listed in the Table.

By supporting the rich feature set defined in modern PDF specifications such as PDF 2.0, publishers can ensure that all readers have an optimal experience with rich content. By further leveraging existing ISO standards such as PDF/UA, PDF/A, and PDF/X, publishers can reduce their costs while meeting regulatory and policy requirements.

Perhaps the most difficult challenges lie in convincing (and helping!) authors to competently use up-to-date, capable application software that will then export best-in-class PDF documents with modern features.

References and Links

1. <https://pdfa.org/wtpdf/>
2. <https://pdfa.org/accessibility>
3. https://en.wikipedia.org/wiki/European_Accessibility_Act
4. <https://pdfa.org/resource/iso-32000-1/>
5. <https://www.pdfa.org/resource/iso-32000-2-pdf-2-0/>
6. Azkue JJ. Embedding interactive, three-dimensional content in portable document format to deliver gross anatomy information and knowledge. *Clin Anat.* 2021;34:919–933. <https://doi.org/10.1002/ca.23755>.
7. <https://pdfa.org>
8. <https://www.editeur.org/8/ONIX/>
9. <https://pdfa.org/archival-pdf/>
10. <https://pdfa.org/resource/iso-15930-pdfx/>
11. <https://www.w3.org/WAI/standards-guidelines/wcag/>
12. <https://pdfa.org/iso-14289-2-pdfua-2/>
13. <https://pdfa.org/resource/iso-14289-pdfua/>
14. <https://latex3.github.io/tagging-project/>
15. <https://www.section508.gov>
16. <https://www.iso.org/committee/53674.htmlmmitee/53674.html>

Future Perspectives: Publishing Integrity Oversight in Scholarly Societies

Elle Thomas, Aashi Chaturvedi, and Kelly Cohen

In an era when scientific communication is under heightened scrutiny, the integrity frameworks of scholarly societies are facing significant transformation, particularly in the research output space. From plagiarism in large language models (LLMs) to conflicts of interest, societies are navigating an evolving landscape of ethical challenges. Publishers play a pivotal role in countering skepticism and fostering public trust through rigorous ethical oversight.¹ Scholarly societies and publishers must therefore adapt their integrity practices to the evolving landscape of research publishing, ensuring their structures can address modern ethical challenges effectively. By examining recent changes and upcoming shifts in ethics structures, we can better understand how publishers are adapting to ensure accountability, bolster detection and intervention methods, and address enterprise-level risks.

Detection Techniques

As the authorship landscape grows increasingly complex, societies of all sizes must adapt to uphold scientific integrity. Large societies with publication ethics frameworks already in place, or those that self-publish, may need to prioritize investments in advanced tools for detecting plagiarism,

paper mill activity, figure duplication for reuse, and data falsification. This includes leveraging software for missing citation detection and artificial intelligence (AI)-driven systems designed to flag anomalies like text generated by LLMs.² For smaller societies with limited resources for developing publication ethics infrastructure or those partnered with external publishers, investing in detection software may not be feasible. In these cases, societies must rely on their publishing partners to develop and implement enhanced integrity tools while focusing internally on bolstering editorial training and raising awareness about ethical publishing practices.

One concern for editors is that tools to find data manipulation or generative AI/LLM content lag behind the abundant programs and techniques for writing and creating research material.³ Manuscript submission and peer review workflow systems should incorporate a range of detection tools into their platforms as well (Figure). As these new tools are developed and deployed by scholarly journals, editorial staff must actively monitor the reports and verify all flagged results, which can add considerably more time to the publishing process. Some tools on the market today have low success rates, or worse, return editors with false positives. Eventually there will be commonplace detection methods, software, and training, but as the market scrambles to catch up, the task of managing, tracking, and whistleblowing falls squarely on those on the frontlines of the peer review process.

All societies, regardless of size or existing infrastructure, must remain vigilant against emerging threats posed by technological advancements that bad actors might exploit. Forums like the Committee on Publication Ethics (COPE) provide valuable spaces for sharing best practices and discussing trends in identifying and addressing misconduct. Encouraging collaboration and transparency between organizations is critical to staying ahead of these challenges. Additionally, the increasing emphasis on open data and metadata as trust signals⁴ highlights the need for accessible and interoperable data to further strengthen the integrity of scholarly publishing.

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Figure. Examples of tools for maintaining publishing integrity. The tools mentioned are provided as examples only and do not represent endorsements by the authors or their organizations.

Intervention Strategies

Although detection is vital, timely and effective intervention is equally critical and often the most difficult part to standardize. Plagiarism cases can be relatively straightforward to address with ethical adjudication workflows. In contrast, cases involving data manipulation often require input and feedback loops from authors' institutions, leading to more complex timelines for publishers to take action. Furthermore, integrity bodies are having to constantly reevaluate how and when to act, often balancing reader transparency with author, editor, and whistleblower confidentiality. For example, scholarly societies are faced with increasingly delineating guidelines on when editors, external experts, or institutional authorities should be involved in cases. Some societies may choose to integrate a tiered approach where subcommittees of editors and/or designated members and staff evaluate cases and escalate them to external review if necessary. Such frameworks could prevent undue influence from stakeholders who may have conflicting interests. Complicating workflows further, some author disputes may result in the publisher handing off adjudication to the affiliation altogether, resulting in the publisher taking no action. To combat this procedural whiplash, societies should develop standard operating procedures to address postpublication disputes, ranging from issuing notes of concern to retracting articles.

However, intervention does not end with punitive measures. Publishers should prioritize training for editors and

peer reviewers to equip them with the tools and knowledge needed to detect data fabrication and citation manipulation. Educating them on identifying inconsistencies, statistical anomalies, missing ethical approvals, and improper citation practices is essential. Offering workshops, webinars, guidelines, and resources help editors and reviewers stay informed and diligent. Training can be tailored to the journal's specific needs, such as focused workshops for early career editors or addressing issues like plagiarism, paper mills, or image manipulation. Emerging topics, such as generative AI in scholarly publishing, may require a more structured approach to disseminate pertinent information effectively and promptly. Presenting these topics during editorial meetings and updating editors on publisher initiatives further reinforces this approach. Additionally, providing resources such as regular blog posts, updated FAQs, reviewer guidelines, and social media-friendly content like short educational videos can significantly support the peer review community. These efforts help maintain a positive environment, foster a growth mindset, and encourage continuous engagement within the peer review process. This proactive approach ensures research integrity, promotes transparency, and upholds the credibility of scholarly publications.

Enterprise Risk Management

Beyond individual cases, the role of integrity oversight bodies extends to managing broader enterprise risks for societies.

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Challenges such as reputational damage, public skepticism, and the global nature of academic publishing require proactive strategies. Transparency in ethics adjudication is paramount for maintaining public trust, especially in an era marked by increased scrutiny of scientific findings, which necessitates clear and accountable decision-making. Scholarly societies are exploring innovative communication strategies, such as public-facing ethics policies and regular reports on resolved cases, making the process more transparent and accessible to the wider community. This transparency not only strengthens accountability but also ensures that ethical considerations are clearly communicated to both the public and the academic community.

The integration of ethics committees into the broader governance structures of societies⁵ enhances their ability to preemptively address systemic risks. By positioning publication-related scientific integrity groups within the larger ethical framework of the society, these bodies can foster cross-functional collaboration and greater uniformity in handling ethical matters across the society. This integration helps bridge the gap between research integrity and other ethical concerns within the scientific community, creating a more cohesive and comprehensive approach to managing ethical challenges.

For example, integrating these groups with other committees, such as those overseeing membership standards or financial transparency, ensures that ethical considerations are consistent across all aspects of the society's operations. In the context of membership, this could involve setting clear guidelines for members to disclose conflicts of interest (COI) related to their research, funding sources, or affiliations. By working together, the ethics and the membership committee can ensure that any potential COIs—whether financial, personal, or professional—are disclosed transparently and managed appropriately. Additionally, these committees can collaborate on establishing ethics training for all members to help prevent inadvertent ethical breaches and to promote a culture of integrity across the organization. Another example could be involving the publication ethics group in discussions around membership eligibility criteria, particularly when there is concern that a member's prior unethical publishing behavior might conflict with the society's values. By embedding these scientific integrity groups within the larger governance structure, the society not only promotes consistency but also strengthens its ability to address systemic risks and ensure that ethical standards permeate all levels of society operations, from research to membership to policy.

Conclusion

Scholarly societies must adopt actionable measures to address ethical challenges in publishing and strengthen the integrity of their research outputs. Key recommendations include:

1. **Invest in advanced detection tools.** Allocate resources for tools capable of identifying plagiarism, image duplication for reuse in figures, and AI-generated content. When applicable, societies should collaborate with publishing partners and systems to leverage these technologies.
2. **Develop standardized intervention protocols.** Establish tiered frameworks that define when and how to involve editors, external experts, or institutional authorities in ethical cases. Ensure consistency across all adjudication processes.
3. **Enhance education and training.** Provide tailored workshops and resources for editors and reviewers on emerging issues, such as generative AI and data fabrication, to promote vigilance and ethical rigor.
4. **Foster transparency and communication.** Develop clear policies to balance transparency with confidentiality and timely community incident reporting, thereby maintaining public trust and credibility.
5. **Integrate ethics into governance.** Ensure ethics committees are embedded within broader governance structures to enable cross-functional collaboration and address systemic risks proactively.

By taking these steps, scholarly societies can safeguard research integrity, uphold ethical standards, and build resilience against future challenges, ensuring that science continues to serve as a trusted foundation for societal progress.

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Looking Ahead: The Research Nexus and the State of Metadata in 2050

Ed Pentz, Martyn Rittman, and Dominika Tkaczyk

As research itself changes, an increasing variety of research outputs are available. *Metadata*—including persistent identifiers (PIDs)—describes the research objects that are essential for discovery, citation, provenance, and trust. In addition to research outputs, the people doing the research, and the organizations funding and supporting the research need to be transparently identified, through, for example, ORCID iDs¹ and ROR IDs.² It is also essential to capture the relationships between these outputs, people, and organizations in an open and dynamic way. Before the digital age, the focus was primarily on the published paper. Now there is open access to datasets, code, materials, equipment, funders, supporting institutions, preprints, posters, and so much more that result from a single project. Each of these components can be reused, repurposed, or discussed as part of a different project. At Crossref, we use the term *the research nexus* to refer to this complex, evolving network of objects, along with descriptions of how they relate.

We see the development and description of the research nexus as key to communicating science in the next 25 years. It is much bigger than Crossref, and a number of organizations are pursuing similar goals from different perspectives. Our contribution is to collect, maintain, and make available identifiers and metadata from the organizations that publish research outputs.³ We also seek to supplement this metadata with other community sources,⁴ and to run automated enrichment strategies at

scale to provide additional metadata and relationships that were not captured earlier.⁵ There is potential for us and others to develop all of these areas in the coming years and decades. We still see a key role for Crossref to gather diverse metadata from the community that can be used and enhanced by others.

Looking Back to Look Forward

Looking back to the state of metadata in 2000 can provide lessons to make predictions about the state of metadata in 2050. Metadata is a very broad area, so the focus here is on scholarly metadata for digital and online resources and Crossref's experience. Crossref was founded in 2000, so how metadata has changed in the last 25 years is reflected in how metadata has changed for Crossref both in what we collect and its purpose. The changes in metadata have reflected the changes in scholarly research and publishing, and this will continue into the future.

The growth of the internet in the 1990s, particularly the World Wide Web, created an urgent need for standardized ways to identify and describe online resources. This led to initiatives like the Dublin Core Metadata Initiative⁶ in 1995, which aimed to create a core set of metadata elements for describing web resources; and the Digital Object Identifier (DOI) System to create a system for persistent identifiers that are also persistent links.

The DOI-X prototype that led to Crossref started in 1999 and created a system for linking journal reference lists.⁷ A persistent identifier and standardized metadata were needed to accomplish this, so the DOI-X project was designed to test out the DOI System, along with basic journal metadata—including only the journal title, first author last name, volume, issue, first page, and article title (which was optional). It was flat, fixed, and covered one type of research output. There were no relationships, and the only other primary identifier included was ISSN.

Over 25 years, Crossref's metadata has expanded to cover 30 research output types, including journal articles, books, book chapters, reference works, conference proceedings papers, datasets/supplementary material,

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dissertations/theses, grants, peer review reports, preprints, working papers, reports, and standards. There is also a richer set of metadata, including licenses, references, abstracts (stretching the bounds of “metadata”), and retractions.

Over time, we have observed a growing need to identify other types of objects within the scholarly record. New types of persistent identifiers emerged, most notably ORCID iD for identifying people and ROR ID for research organisations. As a result, it became possible to capture relationships between objects. We started with citation relationships between research objects, over time expanding to contributor relationships between research objects and people, affiliation relationships between people and organisations, funding relationships between research objects and organisations, relationships between journal articles and preprints, articles and reviews, and many more. We have also moved from seeing the metadata records as static, to more dynamic with updates to the status of an item (e.g., corrections and retractions).

So the story has been one of moving from very flat XML records with minimal metadata for a limited set of traditional scholarly outputs to a rich set of records capturing a broad range of relationships for a much wider variety of outputs and other objects. Crossref refers to this as the research nexus and believes the development and description of the research nexus as key to communicating science in the next 25 years. This reflects how research has been changing, with big data, software, reproducibility, and research integrity all as major concerns. All this open, foundational, scholarly metadata drives discovery services, analytics, and supports open research, which, in the end, increases human knowledge.

There are some things that have been consistent over the last 25 years and will be for the next 25. Metadata acts as trust signals, and so provenance is critical—who created and registered it, who maintains it, and is it open or subject to copyright or licensing terms? Persistent identifiers are also a critical element of metadata—can you link to the research output, or information about it even if it changes location or a different organization takes responsibility for it? With artificial intelligence (AI) chatbots driven by large language models (LLMs), provenance and persistent identifiers are more important than ever because LLMs are statistical abstractions with no concept of citing sources or even providing information that exists (it is common for fake citations and nonexistent identifiers to be generated⁸). Improvements have been made on this front, but it is a problem inherent to how LLMs function, so metadata and persistent identifiers can help solve this challenge.

Research Nexus in 2050

Research practices and outputs will change over the next 5 years. While journal articles will still be important, we expect

that what is considered the scholarly record will expand, and therefore new metadata, identifiers, and relationships will be needed. For example, there will be an increasing need to identify and capture relationships between software code, computational notebooks, virtual/augmented reality experiences, brain–computer interface recordings, AI and machine learning–assisted research, and forms of scholarly communication we have not yet imagined. As a result, new types of persistent identifiers and relationships might be emerging, and the scholarly infrastructure will have to be adapted to handle them.

In the coming decades, we would expect more of a focus on reproducibility and reliability in research outputs. This could mean more of an emphasis on publishing complete results sets, including associated code and data. It is also likely to lead to changes in incentives for researchers: Rather than the traditional publication and citation counts, they may be assessed on the standard of their research practices, broader impact assessments, and activities that take place alongside research (such as advocacy and public engagement). The broadening of assessment approaches will mean a broadening of the need to track a more diverse set of research outputs. Here, the research nexus, and the metadata, identifiers, and relationships that are its foundation, has a key role to play.

The challenge of metadata quality will likely shift from basic accuracy and completeness to capturing nuanced and dynamic context and relationships. In such a complex and dynamic scenario, the scholarly community will increasingly rely on machine learning systems to help identify all relationships both early in the publishing workflows and further downstream. At the same time, we hope automated strategies enriching the scholarly record will be used responsibly—with sufficient quality control, transparency, keeping provenance, and considering the carbon footprint of using resource-intensive approaches. Human expertise will hopefully remain crucial for curating the relationships and controlling what the machines are doing, and that it is done in an open and transparent way. This is especially crucial where the scholarly metadata and relationships are used to make key decisions about research and people. Community involvement and input will also be important in ensuring metadata quality and what policies apply to how the metadata is used and interpreted.

Another challenge will be the globalization of research outputs. Many more regions of the world now generate large volumes of scholarship, and in a wide variety of languages. It is necessary to capture metadata in multiple languages, but also essential that the systems that collect and disseminate metadata are accessible to those whose main language is not English—the current lingua franca. We need to invest in documentation, support structures, and

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knowledge sharing that is adapted to different linguistic and cultural situations, to ensure that there is no regionalisation and fragmentation of the knowledge-sharing infrastructure. For Crossref, a large part of this is listening to the needs of our current, highly diverse membership, as well as reaching out to those who are not yet fully part of our community.

Challenges in Getting There

Cultural change is hard, and in order for the vision of the research nexus to come to fruition, we have to work on open data and open research becoming the default and change incentive structures for how research is assessed. Publishing an article in a high Impact Factor journal is not sufficient. Another challenge is financial—research and scholarly publishing require significant resources, as does the creation and maintenance of high-quality metadata. This all needs support from, and collaboration between, government, funding bodies, research institutions, researchers, open infrastructure providers, scholarly societies, and commercial companies.

A key underpinning for our vision of the future are the Principles of Open Scholarly Infrastructure (POSI).⁹ These are 16 principles covering open data, sustainability, and inclusive governance that are essential for metadata and will continue to be as relevant in 2050 as they are now.

Supporting and embracing technological innovation in a measured way and being globally inclusive are also very

important. More work is needed to expand the scholarly record to more fully include the Global South and expand the scholarly record to cover areas such as grey literature and Indigenous Knowledge.

All the elements are in place for ensuring that in 2050, we will have overcome the current challenges so that metadata supports a fully open and dynamic global research ecosystem.

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on how to adopt them responsibly. A risk management framework tailored to the diverse applications of AI tools is the first step in this process.

By developing clear risk profiles, approving vetted tools, differentiating between substantive and nonsubstantive uses, and implementing reliability scoring systems, publishers can navigate the complexities of AI adoption with confidence. Equally important is the commitment to education and training, ensuring that every stakeholder in the publishing ecosystem understands both the opportunities and the risks of AI.

The future of scientific publishing lies not in avoiding AI but in embracing it thoughtfully, with robust safeguards in place. The responsibility now falls on publishers, editors, and researchers to collaborate in building a publishing environment where AI serves as a tool for progress, integrity, and innovation.

Disclosure

I uploaded lectures and slides I created on my own to ChatGPT for a first draft of this article. I then reviewed, revised, and edited it before sharing with ChatGPT for feedback. After implementing some changes I agreed with, I then uploaded once more to ChatGPT for an edit/proofread. The responsibility for the content in this article is mine entirely.

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Scholarly Publishing and the SDGs: Leading with Purpose for a Sustainable Future

Ashutosh Ghildiyal

As human beings, we often have a tendency to delay action or take things seriously only when a situation becomes critical.¹ Driven by circumstances, this reactive mindset reflects a lack of true freedom and intelligence of mind. It signifies carelessness and indifference rather than thoughtful awareness.

In contrast, nature and the cosmos inherently operate in perfect harmony and order—the very term *cosmos* means order. Yet, human societies, with the structures we have created, are often characterized by disorder. The existence of the United Nation's Sustainable Development Goals² (SDGs) is a testament to the immense disorder we have generated in various forms. At the same time, the global commitment to sustainability reflects a shared desire to address and rectify this disorder.³ However, the demands of business and modern life often place us in conflict with this goal, forcing compromises that challenge our progress.

Sustainability is fundamentally about recognizing the environmental costs of our actions. At its core, it acknowledges that the environment is not separate from us; it is an intrinsic part of who we are. We originate from the environment, are nourished by it, and eventually return to it, while future generations continue this cycle.

Sustainability calls for a shift in perspective: moving beyond immediate goals and necessities to cultivate a holistic consciousness. It reminds us to view ourselves as integral to the environment, part of its ever-evolving process of life. By embracing this interconnectedness, we can act with greater awareness and responsibility, aligning our actions with the broader rhythm of the natural world.

In an era defined by unprecedented global challenges—climate change, inequality, poverty,⁴ and more—organizations across all sectors are being called upon to think beyond mere survival and profit. Scholarly publishers, as the custodians of knowledge and facilitators of academic discourse, occupy a unique and pivotal position in this landscape. They have the potential to significantly impact societal progress by disseminating research that informs policy, shapes public understanding, and drives innovation.

This article advocates for a paradigm shift in scholarly publishing—a new model of enlightened leadership that transcends traditional success metrics and embraces sustainability, equity, and long-term societal well-being as core objectives. By actively supporting the SDGs, publishers can demonstrate their value in meaningful ways, building trust and satisfaction among a diverse array of stakeholders, including funders, institutions, researchers, and society at large.

As the publishing industry becomes increasingly commoditized, stakeholders—authors, researchers, academic institutions, funders, and readers—are seeking greater value from publishers. This value should go beyond traditional metrics and encompass meaningful social and environmental contributions that address the urgent challenges of our time.

The Imperative for Change

Redefining Organizational Purpose

Historically, scholarly publishers have focused on ensuring academic rigor, integrity, and quality. Although these remain crucial aspects of their mission, the current global context demands a broader, more holistic approach—one that aligns with the urgent need for sustainability and equitable development.

Publishers now must envision themselves as key contributors to environmental and societal health. This requires a fundamental mindset shift in which

- the environment is treated as a key stakeholder, integral to the publishing ecosystem's long-term sustainability and relevance;

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- **organizational objectives are aligned with global sustainability goals**, measuring success not only by profit or academic achievement but by tangible contributions to societal and environmental health; and
- **decision-making is guided by a sense of universal responsibility**, ensuring publishers prioritize ethical practices, sustainability, and social impact alongside meeting the expectations of shareholders and the academic community.

This redefined purpose naturally aligns the core mission of ensuring research quality and integrity, with the broader goal of improving the global environment. By connecting their work to a higher purpose—making the world a better place for all living beings—publishers can infuse their operations with greater meaning and impact.

The Role of Purpose in Organizational Success

Teams thrive when their work is rooted in purpose. Although tasks and objectives often dominate the workplace focus, the most successful teams go beyond execution—they connect their efforts to a shared and meaningful goal.

Leaders play a pivotal role in this process by clearly defining and consistently reinforcing a sense of purpose. When teams understand the *why* behind their work, they become more motivated, cohesive, and effective, achieving not only short-term goals but also long-term success.

The benefits of this approach are multifaceted:

- It provides employees with a shared sense of purpose, enhancing engagement, motivation, and job satisfaction.
- It positions the organization as a leader in sustainability, attracting like-minded talent, partners, and collaborators.
- It demonstrates a commitment to global well-being, potentially improving brand perception, loyalty, and trust among stakeholders.

The Triple Bottom Line: People, Planet, and Profit

Enlightened leadership in scholarly publishing requires moving beyond profit as the sole measure of success. A triple bottom line approach—where people, planet, and profit⁵ are given equal importance—should be adopted:

- **People.** Prioritizing employee well-being, diversity, and societal impact by fostering inclusive, equitable research environments. This includes the following:
 - Implementing fair labor practices and promoting work-life balance
 - Ensuring diversity in hiring, promotion, and leadership roles

- Supporting early-career researchers and scholars from underrepresented groups
- Facilitating mentorship programs and professional development opportunities
- **Planet.** Minimizing environmental footprints through sustainable practices, digital innovation, and promoting environmental research. This encompasses the following:
 - Transitioning to renewable energy sources for operations
 - Implementing circular economy principles in production and distribution
 - Developing eco-friendly alternatives to traditional publishing materials
 - Prioritizing and fast-tracking research on climate change, biodiversity, and environmental sustainability
- **Profit.** Ensuring financial stability, not as an end goal but as a means to further mission-driven initiatives that contribute to global sustainability. This involves the following:
 - Reinvesting profits into SDG-aligned research and initiatives
 - Developing sustainable business models that support open access and equitable knowledge dissemination
 - Creating partnerships with nonprofit organizations and social enterprises to amplify impact

This holistic approach aligns publishers with long-term sustainability goals, positioning them as resilient, purpose-driven organizations capable of thriving in an evolving world while contributing meaningfully to global challenges.

Strategies for Advancing SDGs in Scholarly Publishing

Aligning Research Priorities with SDGs

Scholarly publishers can drive global efforts toward solving pressing challenges by prioritizing research aligned with the SDGs.⁶ This can be achieved through:

- special issues or dedicated journals focusing on SDG-related topics such as climate change, poverty, and health disparities;⁷
- curated collections highlighting interdisciplinary research that addresses the SDGs;⁸
- AI-based research discovery tools that help policymakers and researchers identify studies most relevant to sustainability goals;
- developing SDG-aligned metrics for evaluating research impact beyond traditional citation counts; and
- offering fast-track review processes for urgent SDG-related research, particularly in crisis situations.

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Fostering Interdisciplinary Collaboration

Global challenges require multidisciplinary solutions. Publishers are well-positioned to encourage cross-disciplinary collaboration by:

- Creating platforms for collaborative projects that address SDG-related challenges
- Offering incentives like awards or grants for interdisciplinary research focused on the SDGs
- Hosting forums, webinars, and workshops that bring together researchers and practitioners from diverse fields
- Developing special publication formats that showcase interdisciplinary approaches to SDG challenges
- Partnering with academic institutions to create interdisciplinary research centers focused on specific SDGs

Ensuring Ethical and Transparent Research Practices

SDG Goal 16⁹ (Promote Just, Peaceful, and Inclusive Societies), which focuses on peace, justice, and strong institutions, aligns with the need for ethical research practices. Publishers can support this by:

- Implementing robust peer review processes to ensure credibility
- Promoting open data policies for greater transparency and reproducibility
- Encouraging open peer review models, particularly for SDG-related content, to foster trust in research
- Developing clear guidelines for ethical research practices, especially in sensitive areas related to the SDGs
- Implementing blockchain technology to ensure the integrity and traceability of the research process

Amplifying Diverse Voices and Perspectives

Achieving SDG Goal 10¹⁰ (Reduce Inequality Within and Among Countries) involves promoting inclusivity in global research. Publishers can democratize the research landscape by:

- Prioritizing research from underrepresented regions, especially the Global South
- Supporting gender equality in authorship, editorial boards, and leadership positions
- Integrating both traditional and scientific knowledge to include indigenous wisdom and alternative perspectives
- Offering translation services to overcome language barriers in research dissemination

- Creating mentorship programs to support early-career researchers from underrepresented groups

Leveraging Technology for Greater Impact

Technological advancements offer opportunities to scale SDG-related research. Publishers can:

- Develop AI tools for evaluating manuscripts based on their contribution to the SDGs
- Create digital resources that make research more accessible to decision-makers and the public
- Use blockchain for transparency in research funding, authorship, and dissemination¹¹
- Implement virtual and augmented reality technologies to visualize complex SDG-related data and scenarios
- Develop machine learning algorithms to identify emerging SDG-related research trends and gaps

Sustainable Data Publishing

Data is vital in addressing SDGs, particularly in areas like climate change and global health. Publishers can foster sustainable data practices by:

- Encouraging open access to real-time environmental and climate data¹²
- Building infrastructure for long-term data preservation
- Facilitating data-driven collaborations between researchers across borders
- Developing standardized metadata schemas for SDG-related research data
- Creating data visualization tools to make complex SDG-related information more accessible to policymakers and the public

Creating a Culture of Sustainability

To embed the SDGs into their operations, publishers must make sustainability a core value.¹³ This can be achieved through:

- **Education and engagement**¹⁴—Implementing learning programs like hackathons or discussions focused on sustainability.
- **Internal communication**—Using newsletters or meetings to highlight SDG-related impacts and foster collective purpose.
- **Crafting a narrative**—Developing a powerful story about the publisher's role in addressing global challenges.
- **Motivating employees**—Encouraging personal and professional growth through sustainability-focused initiatives.

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- **Leadership commitment**—Ensuring that top management embodies and champions SDG-aligned values and practices.
- **Cross-functional teams**—Creating task forces that bring together diverse departments to work on SDG-related projects.
- **Supplier engagement**—Extending sustainability practices to the entire supply chain and partner network.

Measuring Impact and Progress

To maintain momentum and accountability in advancing the SDGs, publishers must implement effective measures to track their progress. This can be achieved through several key strategies:

- Incorporating SDG metrics into journal and research impact assessments
- Developing citation metrics that capture societal and environmental contributions
- Regularly reporting on SDG contributions to maintain transparency
- Collaborating with external bodies for validation and benchmarking of SDG-related initiatives
- Implementing a balanced scorecard approach that includes SDG-related key performance indicators alongside traditional business metrics
- Conducting regular stakeholder surveys to gauge perceptions of the publisher's SDG contributions
- Participating in industry-wide initiatives, like the SDG Publishers Compact¹⁵ to develop standardized SDG reporting frameworks for scholarly publishing

Embracing Discontent as a Driver of Change

Discontent is the spark that drives our willingness to step into the unknown and explore new possibilities. It is only real discontent that fosters initiative, and without discontent, there can be no growth or transformation. Organizations where nothing changes, where progress stalls, are often those where senior management is complacent—content with the status quo and unwilling to be disturbed. However, disturbance, born from discontent, leads to questioning, seeking, and the initiative that drives growth. Without discontent, there is no initiative, and without initiative, there is no creativity.

To truly embrace the SDGs, publishers must be willing to challenge the status quo.¹⁶ A sense of constructive discontent with current practices can inspire the innovation and creativity required for meaningful change. This approach

involves fostering a culture of continuous improvement, creating spaces where employees feel safe to voice concerns and propose solutions, and regularly reassessing business practices against SDG benchmarks. By embracing discontent, publishers can fuel the innovation necessary to drive real, impactful change.

However, the transition toward aligning scholarly publishing with the SDGs does not come without its challenges. A major hurdle is resistance to change, which can manifest in various ways across organizations. Deep-rooted traditions, entrenched processes, and a focus on profit-driven outcomes can lead to reluctance in adopting sustainability-driven practices. Additionally, some stakeholders may view these changes as threats to established workflows or core business priorities. Overcoming resistance requires clear communication, unwavering leadership commitment, and a strategic investment in training, education, and gradual implementation. By addressing these challenges head-on, publishers can cultivate a culture that values sustainability without compromising operational efficiency or academic integrity.

A Transformative Imperative for Scholarly Publishing

Scholarly publishers stand at a critical crossroads in the global knowledge ecosystem. By aligning their operations with the SDGs, they have the unique opportunity to shape the future of our world. The future of scholarly publishing is intrinsically linked to our collective ability to address global challenges. This transformation demands more than incremental changes—it requires a fundamental reimagining of our purpose, processes, and potential impact.

Scholarly publishers must become active architects of change, not passive disseminators of knowledge. By strategically aligning with the SDGs, they can:

- Amplify research that drives meaningful societal progress
- Create inclusive platforms for global knowledge exchange
- Develop innovative mechanisms for interdisciplinary collaboration
- Establish ethical frameworks that prioritize transparency and impact

The path forward is neither simple nor guaranteed. It demands courage, systemic thinking, and an unwavering commitment to transcending traditional boundaries. Publishers must cultivate organizational cultures that embrace complexity, encourage continuous learning, and

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view sustainability not as an optional strategy, but as an existential imperative.

Now is the time for decisive action. Publishers must lead with purpose, innovate with integrity, and publish with impact—not only for academia but for humanity and the planet. The future we create today will shape generations to come. Let's seize this opportunity to build a more sustainable, equitable, and knowledge-rich world.

By embracing this new paradigm, scholarly publishers can become catalysts for positive global change. They can enhance their relevance in an evolving academic landscape, attract top talent committed to making a difference, forge deeper relationships with stakeholders, and contribute meaningfully to solving the world's most pressing challenges.

The journey ahead requires courage, creativity, and unwavering commitment. We must innovate relentlessly and push the boundaries of what's possible. Only through greater creativity can we drive progress and become true agents of change.

The rewards—both for publishers and for the planet—are immeasurable.

Disclosure

Generative AI tools were used for editing, proofreading, and rewriting some parts, based on my original drafts.

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The Future of Medical Editing: My Experience at the JAMA Network Internship

Melissa Leon

The JAMA Network journals—like many medical journals—publish extensive research on the effects of systemic racism on health and the health care industry. It is now well-understood that we need a health care workforce that matches the diversity of the United States and that of other countries, in terms of sex and gender, race and ethnicity, disability, and socioeconomic background. Among many obstacles, an important one is a pathway problem; that is, not enough candidates join the field who are underrepresented in medicine. These opportunities and obstacles also apply to medical editing.

The JAMA Network medical editing internship program is designed for a third- or fourth-year college student who is underrepresented in medical editing. The goal is simple: to introduce young people to the field so they know to look for these sorts of jobs when they graduate and can succeed when they are hired.

We met a number of excellent candidates—so many that we plan to expand the program in the near future—and ended up bringing on Melissa Leon, a third-year student at the University of Illinois at Chicago. Twice a week for 8 weeks, Melissa worked closely with manuscript editors, managing editors, editorial assistants, and our graphics and proofreading teams to see how an article goes from acceptance to publication. Along the way, she received the greatest hits of the *AMA Manual of Style*—everything from correct and preferred usage to statistical editing.

Our hope is that this program continues and expands and is adopted by other major medical journals so that,

like the field of medicine, medical editing can benefit from diversity and inclusiveness.

—Jen Phillis, Senior Manuscript Editor, the JAMA Network

Reflecting on my recent internship at the JAMA Network, I realize it was not just a professional engagement but a transformative journey. This experience has helped shape my career aspirations, honed my skills, and offered me invaluable insights into the field of medical editing. Here, I share my personal journey: the challenges faced, the lessons learned, and the profound impact this internship has had on my career trajectory.

Background

As a first-generation student at the University of Illinois at Chicago (UIC), I have been pursuing my Bachelor's degree in English with a concentration in Professional Writing and Publishing. Going into university, I was unsure what I would do with my English degree on entering the workforce. I had always known that I wanted to go into the editing field, I just was not sure how. That was until I applied to the JAMA Network medical editing internship program for undergraduate students and received the experience that helped align my future endeavors. As good fortune would have it, I was accepted into the Summer 2024 program and became the first manuscript editing intern to participate in the program.

Gaining Experience

The JAMA Network includes 13 medical journals: *JAMA* (*Journal of the American Medical Association*), *JAMA Network Open*, and 11 specialty journals.

Over the 8-week internship, I worked closely with my manager, Jen Phillis, and 9 other members of the in-house JAMA Network editors. In the first week, I adapted to the schedule of the hybrid internship; on the first day I would meet with a member of the editorial team and review a section of the research manuscript articles (i.e., abstract, results, tables, figures, and reference section). The next day, I worked remotely and practiced asynchronously what

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Opinions expressed are those of the authors and do not necessarily reflect the opinions or policies of their employers, the Council of Science Editors, or the Editorial Board of Science Editor.

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I had learned the previous day. The *AMA Manual of Style* was the foundation of my editing. I referred back to it for any questions or specific technicalities regarding editing a research article. From correct and preferred usage to statistics queries, I referred to it often.

Over the 2 months, I was given practice assignments to become familiarized with editing different sections and the requirements. Then I worked on editing different types of manuscripts, such as research letters, commentaries, and full research articles. Afterward, I met with my assigned editorial colleague for the week and received written and verbal feedback for my edits. Feedback was a crucial part of the internship because I wanted to learn how I could improve my editing toolbox. Additionally, I asked multiple questions and took notes of the revisions so that I could keep them in mind for the next manuscript.

Through the JAMA Network, an article-based network for physicians and researchers, I collaborated with other team members on the editorial team, including editors, HR specialists, and graphics specialists. I attended a JAMA Network town hall meeting, a collaborative meeting where the editorial and publishing staff met and shared their progress in their specific subdivision of the JAMA Network. Working with JAMA Network's diverse editorial teams provided me with different perspectives and intelligence from various people, including the specific role every team member plays in the transformation of a raw manuscript to a polished, published article. The internship has also shown me the importance of collaboration and remaining open-minded to different editing techniques. I have gained a deep understanding of the technical aspects of medical editing and learned how to effectively communicate with authors to query for specific data regarding their research.

Editing authors' and physicians' research manuscripts has proven to be one of the backbones of society, as it is among one of the most important jobs for clear and concise communication. I have also learned that when you are passionate about something, your job will not feel like work; rather, it will be a source of joy and accomplishment over the course of a lifetime.

Long-Term Goals

Interning at the JAMA Network has reinforced my love of the written word. I can more clearly visualize the trajectory of my career path in this field and how to become a successful manuscript editor in the future. Being able to follow my dreams while truly enjoying my work is something that I have desired since I first began my undergraduate training.

Thanks to my experience this summer, on my return to school in the fall, I plan to take more classes specifically geared toward the editing industry, as I want to expand my knowledge on the editing and publishing field. Furthermore, I will begin a position to work in the UIC Writing Center, a collaborative place for writers to talk to fellow peer tutors regarding their writing. I believe my communication skills, my experience with editing, and my ability to listen and receive feedback will perfectly align with this position in the fall, and I look forward to bringing the skills I learned at the JAMA Network with me in the future.

The JAMA Network internship has solidified and confirmed my love of the editing and writing field, and it has improved my skills, such as attention to detail, organization, and clear communication, all of which will serve me well in my career aspirations and my future.

Judith Barnsby: On Her Career, Open Access, Artificial Intelligence, and Public Trust in Science

Eleonora Colangelo, Jonathan Schultz, and Janaynne Carvalho do Amaral

A leading figure in scholarly publishing for over 30 years, Judith Barnsby has shaped the field by connecting quality with Open Access (OA). Since joining the Directory of Open Access Journals (DOAJ) in 2015, she has served as Senior Managing Editor and later Head of Editorial, overseeing the evaluation of journals to ensure high standards and ethical practices. Under her guidance, DOAJ has become an authoritative entity determining the quality of OA journals.

In an interview with Eleonora Colangelo (Frontiers) on January 6, 2025, Jonathan Schultz (American Heart Association, *Science Editor*), and Janaynne Carvalho do Amaral (University of Illinois Urbana-Champaign), Judith reflects on her career and shares insights on what the publishing landscape might hold for the future. She discusses the challenges of predatory publishing, the transformative potential of artificial intelligence (AI), the possibility of journal obsolescence, the risks to digital preservation, and the need for equity and inclusivity in global publishing, for both researchers and professionals.

Eleonora Colangelo: You have had an incredible 30-year career in scholarly publishing and have made a significant impact through your work, with both nonprofit society publishers and service providers. Joining DOAJ in 2015 seems like the perfect culmination of your remarkable career. What initially attracted you to this field, and how did your path specifically lead you to join DOAJ?

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Judith Barnsby: I never intended to go into publishing. I think many people enter publishing by accident, and I didn't really have a specific career plan in mind. After graduating, my first job was in an analytical chemistry laboratory, but I quickly realized that lab work wasn't for me. I applied for and got a job as an information scientist at the Royal Society of Chemistry, where I initially worked as an abstractor on the *Analytical Abstracts* database. That was my entry into publishing.

My career path wasn't really planned out. At one point, I wanted to relocate because I was in a long-distance relationship. I moved to Bath, where I live now. My new role was in marketing, and it was an exciting time because it coincided with the early stages of putting journals online. We provided a hosting service and collaborated with forward-thinking publishers interested in publishing their journals online. I was part of a publisher liaison team, which marked the beginning of my work with online journals. I created web pages for journals, worked with publishers, and managed access control.

Eventually, my role expanded in publisher liaison, and I worked with a large number of publishers. I later joined IOP Publishing, managing the journal service and getting involved in metadata and publishing standards. After taking a break, I found myself again with an unexpected opportunity. A friend who worked at DOAJ posted a temporary job on Facebook, and I decided to give it a try for what was supposed to be 9 months. Nine years later, I am still there. My responsibilities at DOAJ have evolved from reviewing journals to more managerial activities, leading to my current role as Head of Editorial. As you can see, there hasn't been much of a plan, but it has been an interesting journey!

Janaynne Carvalho do Amaral: I see that you have many roles, and I am curious to hear more about your position as Head of Editorial at DOAJ. What would you say about your

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tenure, and do you have, or did you have, a favorite role in your career?

JB: It is hard to have a defining moment, but I would say there are 2 things in particular at DOAJ. One is that I think I brought them a better understanding of how publishers work, because when I joined DOAJ, it was quite a small team, mostly composed of researchers and librarians. Throughout my time there, and especially in recent years, I have been focused on improving our processes to be more efficient. When I joined, there was a big backlog of journals awaiting review, sometimes taking over a year to be reviewed. I prioritized reducing this backlog, and now we are reviewing journals in about 3 months, handling about 8,000 applications a year, making us much more efficient. We have built an editorial team that can manage the workload, with a wide diversity of people from different parts of the world, which is really beneficial. We have recently added team members from Indonesia and Turkey, 2 key countries for OA. We are aiming to have a global view of the publishing landscape and cover it as best we can. So, I joined a small team, and now I am part of a larger, more efficient, global, and professional team.

Jonathan Schultz: I am guessing that many of your efforts to make processes more efficient have been scalable because the number of journals you review must have increased during that same time period, right?

JB: One of my hopes for the future is to be able to use AI or other automated tools to make certain tasks easier. But currently, it is still a very manual process. It is a matter of looking at each journal and determining whether it meets our established criteria. Sometimes, especially when evaluating journals that might be predatory, you really have to dig deep. At the moment, there is no real substitute for the human brain in identifying some of the red flags we use when examining those kinds of journals. So, in terms of scaling, we've mostly had to increase the number of people involved. Hopefully, in the future, some of these manual processes will be more automated.

JS: I would like to transition to getting your reflections on the wider industry. Over the past 3 decades, working with many different actors, you have probably witnessed a lot of monumental changes in the scholarly publishing landscape. In your view, what have been the most transformational shifts, for better and for worse?

JB: Hearing that question really made me think back to when I started as an abstractor. We received print versions of journals sent from places like Japan, India, or the U.S. We

wrote abstracts on forms, which were then sent to a pool of people to type into our system. We proofread enormous computer paper printouts, and everything was put on a big tape and sent to the printer at the end of the week. That process feels like the Dark Ages now! This encapsulates the change from when I started to where we are now. When I began working on online journals, it was really the start of the World Wide Web, and I think that was the biggest change we experienced. Suddenly, you could move from a print journal sent around the world to accessing individual articles instantly online. Over the whole 30-odd years, that was the most significant change. The web is ubiquitous now, but back then, we trained people to do searches on our database using a command line on services like Dialog or Data-Star. You had to type in the exact search, and pay for the results, which made it interesting because every mistake was costly. If you wanted 10 results and got 100 by mistake, it was quite a disaster.

In terms of where I am now, OA is another major shift. It has positives, such as increased access to content, which is wonderful. However, it also has negatives, like the entrenchment of big publishers, who have successfully navigated the move to OA, which may not benefit the wider scholarly publishing industry. At DOAJ, we have seen the rise of predatory publishers, another side effect of the move to OA. When I started at DOAJ, they were quite amateurish, but now they are very sophisticated. This poses a significant challenge, both for us, aiming to maintain a trusted journal database, and for researchers, who need to discern good journals from bad ones. It is especially concerning when journals are posing as reputable ones, attracting contributors from the Global South who are misled into publishing in poor-quality journals.

EC: Discussing the pros and cons of scholarly publishing for how it stands now naturally leads to the next question on OA. It was a revolutionary concept not long ago, but now it stands at the forefront of scholarly publishing. The question here is twofold: How do you see this evolution, and what do you think will be the next major revolution in the industry?

JB: One of the things I have been criticized for over my career is my tendency to see the potential for misuse in new developments. I often take a practical approach, asking, "Here is the change you are interested in. Have you considered how it might be used differently from what you imagine?" Unfortunately, we have seen some of that with OA over the last 20 years. Ideally, OA should be open and equitable, allowing everyone to read the papers they want and publish where they want. However, that hasn't always been the case.

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As for the next big thing, I can't see much beyond AI at the moment. There is so much to consider regarding how it can be used for good—how publishers can utilize its capabilities to make processes better and more efficient, and how it can assist human editors in making good decisions. But it is also crucial to recognize unethical use and learn how to combat it. We are seeing publishers working together now to address this, which is really important. They are sharing experiences from the past few years which is good because, to be honest, I don't see unethical use diminishing. People are quite clever, and someone will always find new ways of doing things. For instance, publishers in recent years didn't expect guest editors to publish subpar content in special issues, nor did they expect people to publish nonsense papers with AI's help. One of the challenges for publishers is to think like the "bad guy"—to foresee potential misuse and ensure it can't happen to them.

JA: Identifying predatory journals is challenging, especially with new developments and issues regarding AI. What makes a good journal, and what defines quality amidst all this? Since quality is at the heart of DOAJ's mission, could you talk a bit more about the dramatic changes or grey areas that journal editors and publishers might face in the near future?

JB: One of the challenges we face at DOAJ is distinguishing between journals that are predatory and those that are simply not adhering to best practices due to low quality. Particularly for new journals or those led by individuals without a publishing background, there is a need for education on best practices. I recall a journal we removed from DOAJ because it appeared predatory, publishing many papers quickly and significantly increasing their APCs (article processing charges). However, some industry colleagues familiar with the journal argued it wasn't predatory but had become overwhelmed by too many submissions without enough editorial resources. They hired a consultant to help manage their workload more effectively. This taught us that journals might inadvertently slip into poor practices, and some need guidance rather than punishment.

At DOAJ, we aim to discern when a journal requires assistance vs when a publisher is acting with ill intent. It is a balancing act when deciding whether to index a journal or publisher. This process can feel like detective work—verifying claims such as whether a journal is truly based at the location it claims, for example, whether the "American Journal of Whatever" is actually based in the U.S. or elsewhere. This involves investigating ownership and links with other questionable publishers.

Journal editors and publishers need to ensure the quality of the content they publish and have procedures to

filter out undesirable papers. There is also a need to ensure equity in publishing, allowing everyone the opportunity to publish in their chosen journals. Many authors are priced out by high APCs. Even with waivers for the poorest countries, other researchers, such as those in India, might not receive waivers, facing APCs equivalent to 6 months' salary. Addressing such inequities is a broader industry challenge beyond the responsibilities of individual journal editors.

JA: Can the journals that are removed from DOAJ reapply?

JB: Yes, journals can be removed from DOAJ and then come back again. After a certain period we specify, they can reapply. However, there are some journals that we know we will never allow back because we have discovered enough about them to be certain they won't meet our standards.

JS: You mentioned looking forward, and I want to focus on that specifically. We are doing this special issue now in 2025 because we are a quarter of the way through the 21st century. We are thinking about what the halfway mark might look like in another 25 years, especially regarding OA. If you were in 2050 reflecting back, what do you think might be considered relics of the past, or what challenges do you think we will still face 25 years from now?

JB: It is challenging to predict the future, as it is hard to imagine today's landscape from when I started in publishing. However, I would hope that in 25 years, the obsession with impact factors and the "publish or perish" mentality that drives the excessive number of publications will have diminished. Regarding OA and publishing in general, I would like to see restrictive copyright gone, allowing authors to use their papers freely without transferring copyright or exclusive licenses to publishers. It would be fair since they are the original creators.

One interesting thought, prompted by past discussions, is whether journals will still exist. I have had many conversations where people proclaimed "the journal is dead," yet it persists largely unchanged. The structure of academic papers has remained similar for centuries. There was once talk of everything becoming interactive and multimedia, but most papers today are still relatively static PDFs, sometimes with supplementary data or a video abstract.

There is a shift toward preprint servers and research platforms, but the journal brand remains strong, serving its purpose to gather papers on specific subjects or serve society memberships and community segments. I will be interested to see if the journal concept endures, but I am not convinced it will disappear.

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EC: You have navigated significant technological and procedural changes throughout your career. If you could go back to the beginning of your journey, what advice would you give your younger self?

JB: That is a really interesting question, and there are definitely a few things I would mention. Reflecting on my career, especially during high-pressure jobs, I would advise managing your stress. No job is worth compromising your well-being. For those early in their careers, I suggest considering your work-life balance. It is important to focus not just on your job, but also on your life and what makes you happy.

So, don't pressure yourself to be successful if it doesn't make you happy. I have left jobs and moved to new positions at lower levels, only to work my way back up again later. It hasn't hurt my career overall, but it positively impacted my well-being.

JA: You mentioned concerns about making publishing inclusive for all authors. On the other side, we have seen many initiatives to make publishing roles more inclusive as well. What advice would you offer to the next generation of editors entering the field of scholarly publishing?

JB: That is a great point about making roles equitable. In my experience, publishing has generally had a good male/female balance, but it's often been predominantly white. It is important, especially in the Glosbal North, that we better reflect society in the publishing industry. One of the nice things about being at DOAJ is that we have a global focus and a more diverse team than I have experienced elsewhere, which is really rewarding. We also have volunteers from all over the world.

For someone entering publishing, my advice is to embrace new technology. Never be afraid of it, and take opportunities as they arise.

Build your network, as publishing is quite a small industry. If you are not happy where you are and want to move, your network can help you find new opportunities. I got the DOAJ job because it was advertised by a former colleague on Facebook, and we were connected there. While I didn't originally build my network for that purpose, having connections from various conferences and interactions proved invaluable. So, having people who know you can lead to new opportunities.

Networking is key. Connect with people, and that network will be useful throughout your career.

EC: Before we wrap up, I wanted to touch on artificial intelligence and machine learning. How do you see these technologies reshaping scientific editing and publishing in the next decade, more practically?

JB: Well, we already see some of the bigger publishers using AI for decision-making, such as assigning reviewers. I think this is only going to grow. Especially in publishers that have forward-thinking technological teams, there is huge potential for incorporating these technologies. Honestly, the sky's the limit. But, as always, we have to think about the implications. One key consideration is how these machines are learning—what information set are they being trained on? Particularly if we are giving them decision-making capabilities, we need to ensure the training data is comprehensive and unbiased. For example, when it comes to equity: if the dataset doesn't include enough papers from certain countries, how will the AI handle submissions from those regions? Will it unfairly reject them because they are underrepresented in the training data?

There are important questions to address when shifting decision-making from humans to machines. Computers often make the wrong decisions, not because they are inherently flawed, but because humans didn't program them correctly. I think AI will certainly reshape scientific editing, and I hope it does so equitably, while still giving editors the authority to override AI decisions when needed. It is vital that editors remain the ultimate arbiters of what goes into their journals—not an AI system, no matter how well it is trained.

I can't predict exactly how things will change, but looking back at the last 30 years, it is clear that change is inevitable. My hope is that AI tools won't exacerbate the divide between wealthy publishers and those without resources. In global scientific publishing, we need to ensure that underrepresented voices—whether from specific regions or disciplines—are not left behind. Diamond journals and smaller publishers, which often lack substantial funding, must also have access to these technologies.

This brings up another point: equity isn't just about authors—it is also about journals. In the past, when journals were in print, they were preserved in libraries around the world. Now, if a journal's website goes down and there is no digital preservation policy, that content can be lost forever. Unfortunately, under-resourced journals often don't have preservation measures in place. As the industry moves forward, it is critical to address this.

We need to ensure that as more journals are published exclusively online, they are safeguarded from being lost when a journal folds. This is already happening, and it is a real danger. I think the richer parts of the publishing industry should support the less-resourced ones—whether through subsidies or shared services. It would be wonderful to see more of that collaboration and mutual support in the future. That would be a truly positive development for the next 25 years.

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JS: You mentioned opening copyright, OA, and the role of AI. With AI potentially using this content in their tools, we might also see a decrease in the value of the journal as a bundle or a gatekeeper. What do you think will mediate that? Do you see the role of an advanced, future version of the DOAJ—maybe for AI databases? What do you think the role of an organization like DOAJ could be in that framework?

JB: I am not convinced that journals are going away anytime soon. I think DOAJ is fairly secure for a while, but you are right that if the concept of journals starts to fade, it leaves a gap. Someone has to be the gatekeeper. Someone will notice that and step in, though it might not be the first person who tries it. Someone else might come along and do it better.

The challenge is: without journals to hold things together, what will give one paper credibility over another? Without journals, who handles peer review? There are different levels of peer review quality, with some better than others. How will you identify quality across papers? You read them, but there is just so much content out there. Without journals, the sheer volume could be overwhelming.

I am not sure what the service that fills that gap would look like. But I agree, there would be one—someone will provide that service. Whether it would be someone like DOAJ, I am not sure since we are focused on journals. Acting as a gatekeeper at the article level would exponentially increase our workload.

If journals really do disappear, it would lead to interesting changes. In 25 years, it might surprise us, and it likely won't be what we expect. I certainly couldn't have predicted today's landscape at the start of my career.

JA: You mentioned that it is very important to trust what we read today. Do you think a lack of transparency would impact public trust in science, both among academics and nonacademics? How might this affect the trust scientists have in each other if there is no clarity on how AI tools are used by editors and publishers?

JB: It is a bit unclear at the moment. There are many instances where people aren't sure where AI is being used and where it isn't, or what is considered acceptable use of AI. I do think there is a risk that trust could diminish. You are right—transparency is really important. For publishers using AI in their editorial systems, it would increase trust if people knew where an editor is making a decision versus where AI is involved.

For example, if AI suggests reviewers, how easy is it for the editor to override those suggestions and choose others? Similarly, editors should know where authors have used AI, whether just to polish the English or in other

areas of the paper, because we know AI can create fake references. You make a great point that transparency on both sides is crucial. We should encourage editors to clearly state where they are using AI and require authors to do the same. Transparency in decision-making is important wherever possible.

As an organization, we have to be mindful about being transparent because we want to provide journals with feedback when we reject them, but we also need to be careful not to reveal too much to predatory publishers about how to game the system. It is a balance of how much to disclose, and it is often easier said than done.

EC: I would like to conclude with a question about your legacy and the impact of your work on future generations. Let's approach this with an optimistic perspective. What is one thing you hope the publishing community and your organization will continue to focus on after you step back from your role? And, as someone passionate about detective fiction, what predictions might you offer as a "detective" of scholarly publishing quality?

JB: I hope for DOAJ that they will continue to provide their trusted service. I also hope that, for the publishing community in general, publishers and editors can navigate these slightly tricky waters we are in, ensuring they provide trusted services. It is crucial that people know the papers in the journals they are publishing are written by the authors they claim to be, are properly peer-reviewed, and meet the quality standards we want to see in publishing. Hopefully, we can remove some of the menace of the bad practices we are seeing at the moment.

I would like to see people trusting the scholarly literature because that is really, really important. There has been a danger, especially with recent issues, that people don't trust anymore. In an age of disinformation and misinformation, being able to trust what you read is really vital.

From a DOAJ perspective, I would also like to ensure that the community continues to support essential infrastructures, particularly those sustained by voluntary donations like DOAJ. There is a lot of emphasis on the importance of DOAJ, but some people don't follow that up with financial support. Services like ours really need backing from the whole community—libraries, publishers, vendors, etc.—so that we can continue our work.

It is an interesting time to be retiring because there are still so many challenges. When I look back, they are very different from the challenges we faced when I started in publishing. Back then, nobody really thought about issues like research integrity in the way we do now. That is a key difference: technological advances have made addressing these issues easier. But I shouldn't get pessimistic.

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I have loved working in scholarly publishing. It is a great field. You learn so much—not just about the subjects you are involved in, but also about how publishing works, how research works, and about standards, metadata, and quality. It is also a really nice community to work in.

When I was made redundant, I went to some interviews for jobs in other sectors. But then I attended an online conference, and I thought: why would I want to work anywhere else? Scholarly publishing felt like home, so I stayed. It is something to be cherished, and it is up to all of us to make it as good as we can.

CSE 2025 Annual Meeting: Join Us in Minneapolis!

CSE Program Committee

As we approach the kick-off of the 2025 CSE Annual Meeting,¹ we're reminded that it's more important than ever to come together as a community to navigate the societal changes impacting science and scholarly communications. We invite you to join us May 3–6 in Minneapolis, Minnesota, for a metaphorical tour of publishing from the past, through the present, and onward to the future. Events will occur onsite at the Renaissance Minneapolis Hotel, the Depot, a former train depot located in the historic Mill District of Downtown Minneapolis.² With easy access to the Mississippi River, gourmet dining experiences, and a thriving arts and entertainment scene, there's plenty to explore between the stimulating programming.

After a buffet breakfast networking with colleagues old and new on Monday morning, wake up with an original musical production titled, "Publish Like It's 1999!" where the ghosts of publishing past, present, and future will celebrate our industry. From there, take a journey through the present state of publishing with more than 20 concurrent sessions to choose from on Monday and Tuesday. This year, we are offering 3 main tracks on popular topics—AI, DEIA, and research integrity—in addition to smaller tracks on professional development, production, and business operations that are core to CSE's mission. Sessions will cover such wide-ranging topics as article reach, the recent US executive orders' impacts on publishing, accessibility in the industry, publishing partnerships, an interactive knowledge exchange roundtable, and much more! Use the event app to personally curate your schedule to meet your needs.

The final morning of the annual meeting will feature the popular Ethics Clinic, hosted by the CSE Editorial Policy Committee. This year's theme will focus on AI and ethics, with full audience participation to discuss case studies that explore how our industry is addressing the many different facets and approaches to AI usage and concerns.

The conference will conclude with a general session inspired by the March 2025 *Science Editor* special issue. This closing session will bring together thought leaders to speculate on the future of scientific publishing, peer review,

open science, journals, research integrity, and more, while grounded in the reality of our uncertain, ever-changing present. Attendees are encouraged to come prepared to ask questions and contribute their own insights.

Our schedule will also contain 5 short course add-on options, including the Short Course for Manuscript Editors and the Advanced Short Course on Publication Management.³ As in past years, short courses will feature subject matter experts and take place on Saturday and Sunday ahead of the main annual meeting events.

While you're in town, make the most of the various networking opportunities offered throughout the event. Browse the booths in the exhibit hall to meet publishing experts and discuss your organization's unique needs, and be sure to catch the Welcome Reception, President's Reception, and Awards Luncheon, all included with registration. Back by popular demand are Dinner Conversations on Sunday and Monday evenings—sign up through the event app to be connected with a group of attendees for an evening of good food and even better company. On Sunday afternoon, join a group for a trip to the famous Mill City Museum or a walking tour of the Mill District. We will also offer Tuesday-morning yoga and on-site professional headshots; spaces are limited, so be sure to indicate your interest upon registration.

Join us in Minneapolis as we navigate the changing scholarly publishing landscape together!

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ScienceWriters 2024: Some Highlights of the Virtual Sessions

Rachel Sells, Katherine Hollen, Grace Aneska Cote, Lalain D Aquino, Erin R Wunderlich, and Barbara Gastel

Retaining the structure that had served its recent predecessors, the conference ScienceWriters 2024—organized by the National Association of Science Writers and the Council for the Advancement of Science Writing—consisted of virtual-only sessions on October 17–18, 2024, and in-person components in North Carolina’s Research Triangle on November 8–11. The current report presents highlights of the virtual-only sessions, which were largely panel discussions featuring science writers, science editors, and related professionals.

Free Your Data and Your Mind Will Follow: Exploring Journalists’ Role in the Open Data Movement

By Rachel Sells

Large datasets can be crucial in reporting, but accessing and interpreting them can pose challenges. This issue was explored by a panel moderated by Maggie Koerth (editorial lead, CarbonPlan) and consisting of Tyler Dukes (lead editor, AI innovation in journalism, McClatchy), Lisa Sorg (adjunct professor, Wake Forest University, and North Carolina reporter, Inside Climate News), and Max Jones (cloud engineer, Development Seed).

The panelists started by discussing journalists’ access to data. As a commodity that businesses rely on, they said, data can be tricky to access. They discussed the need to promote equity in data access through outreach, open data policies, and implementation of accessibility tools. Privatization of data was noted as a concern, and, speaking on a lighter

note, Sorg later brought up her frustration with the loss of phone books.

The conversation shifted to issues with open data, especially data obscuration. Sorg cited the Duke Energy groundwater contamination incident as an example of intentional obscuration by using an inaccessible format. The panel also discussed unintentional obscuration, such as when data is provided in a format accessible to only part of the audience. For example, PDF files are easy for the public to consult but difficult to extract data from.

Koerth also raised the issue of activism regarding data availability. Jones said he sees his views on open data as values that guide his work as a whole, not a type of advocacy. Dukes said he sees “the process of doing journalism itself as activism” since the journalist is telling the reader what topics are worth attention.

When Words Aren’t Enough: How to Make Visuals Part of Your Storytelling

By Katherine Hollen

This session addressed how visuals can facilitate science communication. Moderated by Rachel Ehrenberg, senior associate editor at *Knowable Magazine*, the discussion featured insights from Jen Christiansen, senior graphics editor at *Scientific American*, and Beth Rakouskas, creative director at *Science* magazine.

Ehrenberg discussed how visuals serve as entry points for readers, particularly through engaging “banner art” atop online stories. She said this art often provides the first impression of a story and encapsulates its essence and themes. A well-crafted banner, she stated, captures attention and sets the story’s tone, enticing readers to explore further. Ehrenberg also emphasized that effective visuals do more than draw readers in; they enhance understanding of complex scientific concepts by letting readers see the evidence or data themselves. This engagement, she said, makes intricate ideas more accessible and relatable.

Christiansen explained that graphics can function as primary and secondary storytelling media. As primary media,

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they convey the full story visually via a clear sequence of information. As secondary media, graphics support text-driven narratives; for example, they can alleviate pressure on written content by extracting dense or explanatory information from the main story, guiding readers through the narrative, and deepening their understanding.

Finally, Rakouskas underscored the power of visuals in capturing attention and driving engagement. Visuals, she said, are crucial for social media outreach—whether through art, photographs, or videos. She noted that posts featuring original visuals consistently achieve greater reach and more engagement than other posts do. She said that as graphics gain traction, they not only expand audiences but also enhance awareness of and interaction with content.

Working Together to Make a Difference: Science Communication Collaboration to Drive Real-World Impact

By Grace Aneska Cote

Moderated by Erika Check Hayden (director, science communication program, University of California, Santa Cruz), this session featured 3 journalists' accounts of their impactful projects.

Filmmaker Elijah Yetter-Bowman discussed his documentary on the dangers of "forever chemicals" in firefighting gear. This initially slow-moving project, he explained, gained funds and momentum through a collaboration with the International Association of Fire Fighters. Yetter-Bowman described premiering the resulting film, "Burned: Protecting the Protectors,"¹ to a ballroom filled with firefighters. He noted that screenings of the film affected policies on components allowed in firefighters' gear.

Rodrigo Pérez Ortega, a *Science* staff writer based in Mexico City, said he was covering a paleontology story when he stumbled on a feud regarding a fossil that was stolen from Brazil and resided in Germany. Acting as a translator and mediator, Pérez Ortega helped bridge the communication gap between the 2 scientific communities. His efforts helped lead to the return of the fossil to Brazil. More generally, his reporting,² based on this situation, shed light on the broader ethical issues of colonialism in science.

Investigative reporter Yvette Cabrera, of the Center for Public Integrity, told of the award-winning series³ she wrote about lead contamination in a Mexican American neighborhood in California. Suspicious that lead exposure might be causing behavioral problems that women in the community were reporting in their sons, Cabrera collaborated with the community and academia to determine lead concentrations in the soil. The findings, including a map of lead concentrations, eventually led to policies to address the hazards.

The Bookmaking Journey in Three Acts: A Guide for Debut Authors

By Lalain D Aquino and Barbara Gastel

At this session, organizer Ferris Jabr and fellow science book authors Zoë Schlanger and Brandon Keim discussed the 3 phases of book authorship: finding an agent and crafting a proposal; reporting, writing, and funding; and publicity and marketing.

Points regarding finding an agent and crafting a proposal included the following: The author and agent should have compatible visions of the book. Writing a book proposal can take several months or more. Examples of successful proposals, which sometimes are obtainable from other authors or from agents, can serve as useful models.

Once a publisher accepts a book proposal, Keim said, prepare yourself for the long journey of writing the manuscript. This journey can take several months to several years. Keim reported experiencing burnout and recommended attending to one's mental and physical health. The speakers also discussed maintaining their financial health, as publishers' advances for science books generally do not suffice to live on. Schlanger mentioned having obtained several writing residencies, which provided both financial support and pleasant places to write. Keim and Jabr mentioned doing freelance writing or editing while writing their books.

In a science book, the information must be accurate. Jabr recommended hiring a third party to fact-check the manuscript. He indicated that different chapters can be checked at different times and by different people.

Keim noted that although publishers market books, authors have more responsibility to publicize them than before. Schlanger reported that meeting readers at events such as book tours has been very rewarding.

Nonhumans as Characters: What to Do When Your Subjects Can't Speak to You

By Erin R Wunderlich

This session addressed how to portray nonhuman characters, living and otherwise.

Moderated by Brandon Keim (freelance journalist), the panel included Bathsheba Demuth (history professor, Brown University), Benji Jones (Vox correspondent), Filipa Ramos (lecturer, Institute Art Gender Nature, Basel, Switzerland), and Jenny Splitter (editor-in-chief, *Sentient*).

Keim said nonhuman species allow for insights into issues such as climate change and habitat destruction. But how to represent nonhuman subjects without overly anthropomorphizing? Demuth said not to totally avoid anthropomorphism, as developing a character promotes relatability. For example, in part through verb choice, she

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conveys in nonhydrological terms what a river does and represents. “Think about a river having a lifespan,” she said.

Splitter addressed using multiple perspectives, noting she often takes a solutions journalism approach—explaining what we do and do not know. She said she strives to answer questions such as what ethical issues exist and what biases people hold. When writing from the perspective of a nonhuman species, she said, avoid advocacy and rely on facts.

Others discussed ways to engage readers. “Make your writing somewhat cinematic,” Jones said. Speakers also said to use descriptive language, convey feelings such as wonder, and envision wants and needs of animals being portrayed.

In closing, the panelists recommended books applying concepts discussed. Among them: *Meet the Neighbors: Animal Minds and Life in a More-than-Human World*, by Brandon Keim; *Pests: How Humans Create Animal Villains*,

by Bethany Brookshire; *An Immense World: How Animal Senses Reveal the Hidden World Around Us*, by Ed Yong; *Arctic Dreams*, by Barry Lopez; and *Atlas Obscura: Wild Life: An Explorer’s Guide to the World’s Living Wonders*, by Cara Giaimo and Joshua Foer.

For information about the in-person sessions—which included professional-development events, science-related tours, networking opportunities, and much more—please see the conference program (at <https://sciencewriters2024.org/session>) and the National Association of Science Writers website (at <https://www.nasw.org/>). Information about plans for ScienceWriters2025 also will appear on this website.

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Inclusivity in Science Communication: Prepublication Perspectives: Webinar Commentary

Eleonora Colangelo, Barbara Gastel, Christopher Magor, and Janayne Carvalho do Amaral

Introduction

In a thought-provoking post from *Retraction Watch* on July 29, 2024,¹ a surprising comparison posed an arresting question: What do fairytales and scientific papers have in common? The answer highlighted a complex issue: Just as fairytales create an illusion, so too can researchers, sometimes unintentionally, generate an “illusion of novelty” in their findings. This happens particularly when results cling to the edge of statistical significance, suggesting something novel without clear substantive weight. This parallel sheds light on a critical, yet often overlooked, facet of science communication: the way research is crafted, communicated, and perceived, even before it reaches publication.

Although distinct in focus, the August 2024 webinar,² organized and moderated by Eleonora Colangelo, and generously sponsored by Digital Science, resonated strongly with the concerns raised in the *Retraction Watch* piece. The overall discussion focused on science communication in the prepublication phase, an area where researchers have the opportunity not just to shape narratives but to engage openly in shaping methodologies, analyses, and findings before they are set in academic stone.

Eleonora Colangelo is Public Affairs Officer, Frontiers; Barbara Gastel is Professor of Integrative Biosciences and of Medical Humanities, Texas A&M University; Christopher Magor is Senior Science Editor, Japan Medical Communication; and Janayne Carvalho do Amaral is Postdoctoral Research Associate, University of Illinois Urbana-Champaign, School of Information Sciences.

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Our webinar speakers offered insights that push science communication toward inclusivity and innovation, emphasizing the need for accessible language and targeted mentorship programs, particularly for early-career researchers and those from diverse linguistic backgrounds. The conversation examined key themes, such as the role of mentorship in guiding researchers, the benefits of inclusive peer review practices, and new peer review models that incorporate broader perspectives. In unpacking these themes, the discussion reinforced the idea that impactful science communication begins well before research sees publication.

Science Editors as Communication Mentors

Barbara Gastel, who teaches science editing and related subjects at Texas A&M University and directs the science journalism graduate program there, discussed providing communication mentorship as a science editor. She emphasized that science editors in various roles are well positioned to integrate mentorship into their interactions with authors and others. Points included the following.

Prime candidates for mentorship by editors include early-career researchers publishing their first few papers, more advanced professionals with little publication experience (e.g., those who recently moved from clinical to academic roles), and authors publishing in a new language or culture (including those publishing in a discipline other than their main one). Some pluses of working with such candidates are their high motivation, the suitable context provided for adult learning, the ability to affect both current and future papers, the chance to train individuals who may themselves train others, and the potential for rapid tangible success. In addition, by helping such candidates write well, the mentorship can facilitate subsequent work by peer reviewers and editors.

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Individuals with various roles in science editing or peer review can contribute communication mentorship in various ways. For example: Author's editors can provide mentorship through "educational editing" which contains more explanation of revisions and suggestions than typical substantive editing does, may have a relatively long and didactic cover letter, and may provide sample corrections and have the author make the rest. Some author's editors, such as those at The University of Texas MD Anderson Cancer Center and those at Nationwide Children's Hospital, also provide educational offerings such as workshops or courses. In addition, author's editors can contribute mentorship through their availability to answer questions, for example, when an author is uncertain how to address an item from a peer review.

Peer reviewers also can contribute mentorship. When reviewing manuscripts by authors who appear inexperienced or otherwise poorly versed, they can provide "educational peer reviewing"—for instance, by including more explanations than usual, demonstrating requested revisions more than usual, suggesting resources more than usual, and perhaps being more tactful than usual. Also, experienced peer reviewers can mentor beginning peer reviewers through "co-peer reviewing," in which (at the editor-in-chief's suggestion or with the editor-in-chief's permission) a senior peer reviewer and junior counterpart collaborate on a review. As described at the 2024 CSE annual meeting, one journal that promotes co-peer reviewing is *Academic Psychiatry*.³

Various categories of editors at journals also can, and do, provide mentorship to current and prospective authors and peer reviewers. For editors of journals from professional societies, a well-established way to do so is through instructional sessions at society conferences. Other means of such outreach include presentations in other contexts, as well as webinars, videos, and podcasts. Some editors also offer guidance through editorials or special articles in their journals. In addition, some journals have fellowship programs in which early- or mid-career scientists or health professionals obtain mentored experience in journal editing and related realms; examples appear in the *Science Editor* article by Semro⁴ and an associated table.⁵ More broadly, journals can promote excellence within their own staff and among authors and reviewers by fostering a "mentorship culture," in which editors-in-chief, managing editors, manuscript editors, and others at the journal view guiding and educating others as a priority.

In short, many aspects of the editorial process in science offer opportunities for mentorship. Pursuing these opportunities can promote excellence in science publication and a humane publication culture in science.

Promoting Better Inclusion of Authors From Outside the Anglosphere

In his talk, Christopher Magor, a senior science editor and Research Integrity trainer based in Japan, discussed some of the challenges multilingual researchers encounter during the publication process. He also presented strategies aimed at promoting inclusive language and providing support to these authors, ensuring they can deliver equitable research outputs. Magor's analysis drew on his experiences as a science editor in Japan. Although it is not clear whether this experience fully reflects the situation in all non-Anglophone countries, he considers it to be representative of the situation in Japan. Following are the key points he addressed in his speech.

According to the Nature Index,⁶ authors from non-Anglophone countries account for almost 60% of English-language publications. It would seem reasonable to assert that this important author group is included in terms of number of publications. However, this does not reflect the overall inclusivity of the publication process. Researchers for whom English is not their first language often face additional costs that researchers from Anglophone countries do not face.⁷ In addition, the time it takes to write an article or to prepare English language presentations can be greatly increased. While it may be impossible to completely overcome these disparities, there are ways in which the prepublication process can be more inclusive.

To gain an overview of the prepublication process, it is important to first consider the pathway of a typical peer-reviewed journal article written by a group of Japanese authors. The typical prepublication editing process looks something like this: 1) the authors agree on the contents of a draft; 2) the corresponding author engages the services of a communications agency (responsible for editing and proofreading) that forwards the draft to an editor; 3) the editor checks the draft, and returns it to the agency with corrections and queries; 4) the agency returns the edited draft to the corresponding author; and 5) the author either re-revises it and returns it to the agency for a second edit or submits it to the journal. It is unusual for there to be any direct contact between the editor and the author as this would place the communications agency at risk of losing business to the editor.

Another challenge, in terms of quality, is that not all people who edit are editors. Much of the work is done by graduate students or postgraduates who work for the larger internationally based agencies temporarily. Depending on the agency, they may receive some training or information about best practices. However, the quality of the output can vary widely.

The editing heatmaps in the Figure illustrate—at the character level—the volume of changes that are made to

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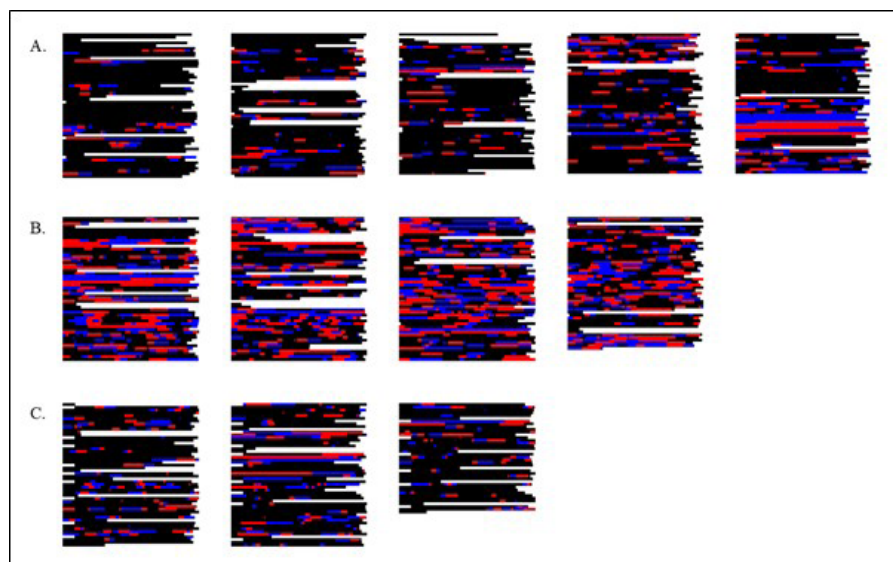


Figure. These editing heat maps were created using a Visual Basic macro for Microsoft Word. Briefly, the macro converts each character to a red (deletions), blue (insertions), or black (unchanged) block based on the tracked changes in the manuscript. The title page, references, and figure legends are removed to focus on the abstract and main text. The font, size (12 pt), vertical spacing, alignment, and margin sizes are unified, and headers and footers are removed. This visual representation provides an approximate reflection of the intensity of an edit. The 3 panels show A) a moderately intensive edit, B) a moderately intensive edit, and C) a secondary edit of a manuscript that was submitted to an English-language journal.

typical manuscripts, with Figure C showing the changes to a short manuscript that was sent for additional proofreading prior to publication in an English language journal in Japan.

When the editing process works as it should, the article is prepared to a publishable or near-publishable state, subject to any changes that are requested by the peer reviewers. However, a high-quality edit is no guarantee of a fair and equitable peer review process. While most reviewers will judge a manuscript based on the quality of the science and the accuracy of the language, Magor still encounters innumerable cases in which reviewers include throwaway comments about language (namely, comments related to language quality that do not reflect the quality of the language, in other words, comments based on the nationality of the author or the location of the research). When discussing this issue with other editors, Magor recalled not being surprised to learn that we had all experienced cases in which reviewers had made throwaway comments related specifically to language and grammar.

In one extreme example, the editor remarked, “The reviewer complained of *wholesale* grammar errors, but when we reviewed the manuscript, we could not find a single error.” For the author, such comments can be an enormous problem. The author’s language ability may not be sufficient for them to judge whether the comments are accurate. In most cases, the manuscript must be reevaluated at the cost of additional time and sometimes money. If the manuscript has been through an editing agency, this sort of follow-up is typically handled for free (and at the expense of paying work). Much of this inconvenience and extra cost would be avoided if the reviewer simply provided specific and actionable comments about what they thought was wrong.

Vague criticisms about language will send the author and their editor searching for an undefined number of needles in the haystack.

In Magor’s experience, there seems to be improvement in the interactions between reviewers and authors for whom English is a secondary or additional language. Reviewers, for their part, seem to be more aware of the challenges that these authors face. To continue this trajectory, and establish a more diverse and inclusive publishing environment, Magor argues that we should actively encourage authors, editors, publishers, and other stakeholders to form direct connections and build professional networks that can connect authors to the support they need during the prepublication process.

(Non)Academic Voices in Peer Review and Science Communication

Open peer review can be implemented in various ways, according to open peer review traits chosen by the editor. Examples of open peer review traits are revealing the identities of authors and reviewers along the peer review process and the publication of reviewers’ reports alongside the paper. In her talk, Janaynne Carvalho do Amaral, social anthropologist and information scientist from Brazil, currently a postdoctoral research associate at the School of Information Sciences at the University of Illinois Urbana-Champaign, presented the structure of open peer review models with public participation implemented in some scholarly and scientific journals, based on her PhD dissertation finalized in 2022, and current research on public engagement with science. As examples of journals, she mentioned *Atmospheric Chemistry and Physics*⁸ (interactive

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public peer review, 2001—includes academic voices), *Journal of Instructional Research*⁹ (hybrid peer review process, 2012—includes academic voices), *Economic Thought: History, Philosophy, and Methodology*¹⁰ (open peer discussion, 2012—includes academic voices), *Research Involvement and Engagement*,¹¹ and *BMJ* (open peer review—includes academic reviewers, patient reviewers, and the public). By observing these models, Carvalho proposed that the meaning of “public” in public peer review may vary from one discipline to another according to the goals and initiatives of each journal. Peer reviewers can be invited by the editor, self-appointed, and/or indicated by the authors. In addition, open peer review models with public participation may be divided into 2 categories: hybrid open with multiple stages and open with one stage divided into steps.

Carvalho argued that open peer review models with public participation can bring a new role to scholarly and scientific journals and be a powerful tool to connect science and society and promote inclusion, diversity, and equity in academia, because it may attract a variety of readers with different experiences and expertise. However, more research needs to be conducted on public participation in peer review—mainly approaching power dynamics among researchers and minorities in science and researchers and the public.¹² Carvalho also connected her perspectives with AIDS activism in the 1990s, which challenged the authority of physicians and scientists with a concern shared among public academic voices and nonacademic voices after reviewing a manuscript: “Being treated as an equal partner in the peer review process—Will the editor/author consider my peer review report?”^{13,14} Including nonacademic voices in peer review may be an opportunity to share our work with the public, learn from the public, and build trust with the public. However, these initiatives must be responsively and reflectively guided not only by scientific evidence, but by active listening, empathy, humility, and respect for other types of knowledge.

Conclusions

In the ongoing journey toward a more inclusive research communication, the prepublication phase stands out as a crucial space for meaningful transformation. It is in this liminal stage, just before research steps into the spotlight, that authentic dialogues begin—dialogues with the potential to reshape the entire scientific landscape. Invited experts illuminated this transformative power, first emphasizing the essential role of mentorship from editors and peer reviewers. For early-career researchers, especially those navigating the intricate waters of multilingualism, such guidance acts as a

beacon. Multilingual challenges faced by many researchers are not merely obstacles but critical gaps that must be addressed. Moreover, the exploration of open peer review models and the integration of public voices into the evaluation process opens up new frontiers in science communication: by welcoming nonacademic contributors into the peer review arena, it is possible to not only enhance transparency but also bridge the gap between science and society. The wish is to see these 3 crucial aspects—mentorship, multilingual tolerance, and the inclusion of engaged nonexpert voices in public science evaluation—more prominently acknowledged in both current and future educational frameworks for science communication professionals.

Disclosure

For Magor’s presentation, generative artificial intelligence (Copilot and ChatGPT) was used to create and refine the Visual Basic code used to generate the Editing Heatmaps and to adjust the size and position of the Editing Heatmaps array in Microsoft PowerPoint. All code was generated with human oversight.

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The Changing Landscape of Open Access Policies and Transformative Agreements

Tom Ciavarella and Eleonora Colangelo

Introduction

The Open Access (OA) movement is at a critical juncture, with stakeholders worldwide seeking innovative models to achieve equitable, sustainable, and transparent scholarly publishing. Transformative agreements (TAs)—defined in key studies as transitional contracts aimed at shifting subscription-based journals toward full OA—have become central to this effort. Although praised for accelerating OA adoption, TAs have also sparked ongoing debates about their long-term impact, financial implications, and effectiveness. The October 2023 CSE webinar, “The Changing Landscape of Open Access Policies and Transformative Agreements,” organized by Eleonora Colangelo and moderated by Tom Ciavarella, provided an in-depth exploration of these issues, offering insights into the evolving role of TAs within the broader OA landscape.

The discussion highlighted several key developments and challenges anticipated for 2024 and 2025. Three prominent voices guided the discussion, each addressing different facets of the OA state of affairs.

Gates Foundation Approach to Open Access

Ashley Farley, Senior Officer of Knowledge and Research Services, the Bill and Melinda Gates Foundation (BMGF), presented a thorough review of the BMGF’s OA policy, from its inception to anticipated developments in 2025.¹ She detailed both milestones and ongoing challenges based on the BMGF’s OA report,² emphasizing the foundation’s

support for rights retention and the Green OA route, and advocacy for emerging models.

As recalled by Farley, funder collaboration has been a cornerstone of BMGF’s OA strategy. The foundation joined cOAlition S³ as a founding member in 2017. By 2021, it aligned its policy with the Plan S principles, including a reduction in funding for hybrid journal models. To promote transparency and fairness in OA costs, the BMGF has also participated in cOAlition S’s Journal Comparison Service.⁴

Addressing the financial and ethical aspects of OA, Farley identified equitable OA publishing as an ongoing challenge. Escalating article processing charge (APC) costs remain a concern: Despite BMGF’s strong publication output and OA compliance rates, Farley noted a decline in articles requiring payments from the Central Fund partly because of grantees’ increased use of institutional TAs and alternative OA routes, even as annual publishing costs continue to rise (Figure 1).

Looking ahead, Farley outlined BMGF’s commitment to leveraging its decade of OA experience to deepen understanding of the movement’s impact. Central to BMGF’s effort has been the creation of Gates Open Research,⁵ a platform founded on the publish–review–curate model, which—alongside other coordinated initiatives and alignment with the Office of Science and Technology Policy’s mandate—has helped establish OA as an industry standard. This forms the basis on which BMGF is building its future strategy: With rising compliance rates driven by institutional mandates, the foundation is now exploring diverse OA models—such as preprints and infrastructure support—to reduce reliance on per-article payments, thus making the research ecosystem more APC-resilient.

Societies and OA

Rob Johnson also addressed economic anxiety, providing an up-to-date perspective on the relationship between learned societies and OA in the context of TAs.

Many learned societies have historically viewed OA with skepticism: Readers may still recall headlines warning of OA as a potential threat, with some even describing it as a “catastrophe.”^{6,7} While learned societies are now

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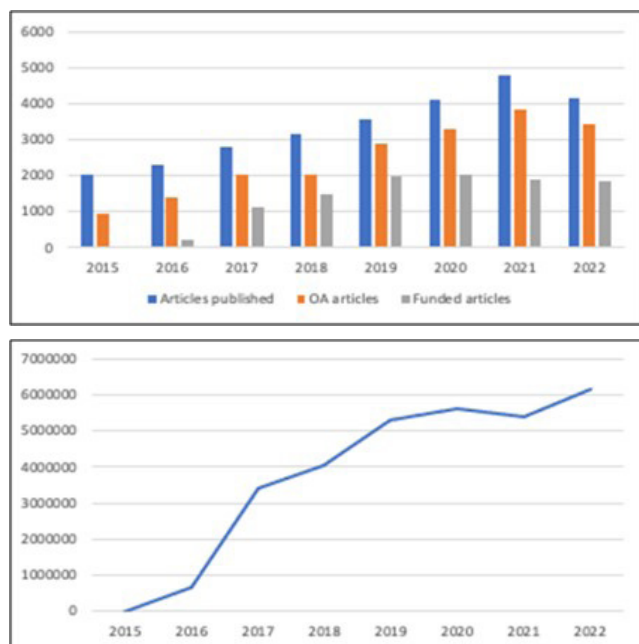


Figure 1. Top The Bill and Melinda Gates Foundation (BMGF) total publishing vs. Open Access. Bottom The BMGF Central Fund payments, 2015–2022.

increasingly embracing OA, adapting their established practices and business models to this evolving landscape presents significant operational and financial challenges.

The numbers speak for themselves. A study by Research Consulting highlighted a shift in the publishing habits of learned societies in the UK, with 68 societies self-publishing journals in 2015, a number that dropped to 44 by 2023.^{8,9} As Johnson explained, many societies find self-publishing too complex and costly, leading them to partner with major publishers or cease publishing altogether, a trend that, although initially observed in the UK (Figure 2), is reflected globally, with notable shifts occurring across the entire industry.

Johnson also considered revenue trends for a sample of the top UK learned societies involved in journal publishing. At first glance, the findings might not seem too alarming (i.e., some larger societies have experienced notable revenue growth, whereas others have seen modest declines). However, a closer look reveals a different story. When presented as a percentage change from 2015, it becomes evident that larger, well-established societies have seen growth, while small- and medium-sized societies have faced substantial revenue losses. In some cases, these societies have seen their publishing revenue drop by up to 100% over the past 8 years (Figure 3).

Similarly, comparing societies that self-publish with those that partner with external publishers shows a marked divide. Large, self-publishing societies have continued to grow

their revenue, while those that outsource publishing have seen significant declines. This trend highlights a broader challenge in the OA landscape, where many societies, once reliant on subscription revenues to support their activities, are now witnessing these income streams shrink as OA models expand. For many smaller societies, negotiating TAs with institutions and consortia is particularly difficult, leading them to partner with larger publishers.

At this point, the outlook might seem bleak, but Johnson highlighted 3 key reasons for optimism. First, the growing focus on research integrity offers societies the chance to emphasize quality over quantity, maintain rigorous peer review, and position themselves in a future where quality is prioritized.¹⁰ Second, there is increasing support for not-for-profit publishing models, with the Council of the European Union promoting community-driven publishing—an initiative that aligns with the broader mission of learned societies.¹¹ Finally, technological advancements, including artificial intelligence-driven editorial processes and data analytics, provide societies with opportunities to streamline operations, reduce costs, and improve efficiency. By leaning into these core strengths (i.e., research integrity and community-driven publishing), societies may not just survive, but thrive, making their outlook brighter than expected.

OA in the Middle East and North Africa

Shifting focus, Kamran Kardan explored the true meaning of embracing OA in the Middle East and North Africa (MENA) region, starting with a telling survey conducted in 2021 during Open Access Week. The survey, which involved nearly 800 participants, revealed significant gaps in understanding—only 19.5% of respondents fully understood OA, whereas 26% mistakenly associated it with predatory publishing. Since first exploring OA for his master's dissertation, Kardan has recognized key issues that continue to influence the region's understanding of the movement (i.e., concerns over copyright, confusion about OA tiers, misconceptions regarding peer review in OA journals, and resistance to APCs).

Diving deeper, Kardan outlined 3 main levels of regional challenges:

- **Researchers** face mistrust and fear of predatory publishers, lack of incentives or mandates, and difficulties in publishing OA research in Arabic.
- **Institutions** struggle with communicating APC workflows to authors, dealing with a variety of publisher business models, and lack of national policies.
- **Libraries** face cost-sharing issues across multiple entities and platforms that often fail to support Arabic script.¹²

Despite the hurdles, Kardan stressed how they have driven more extensive initiatives in the region.¹³ Since

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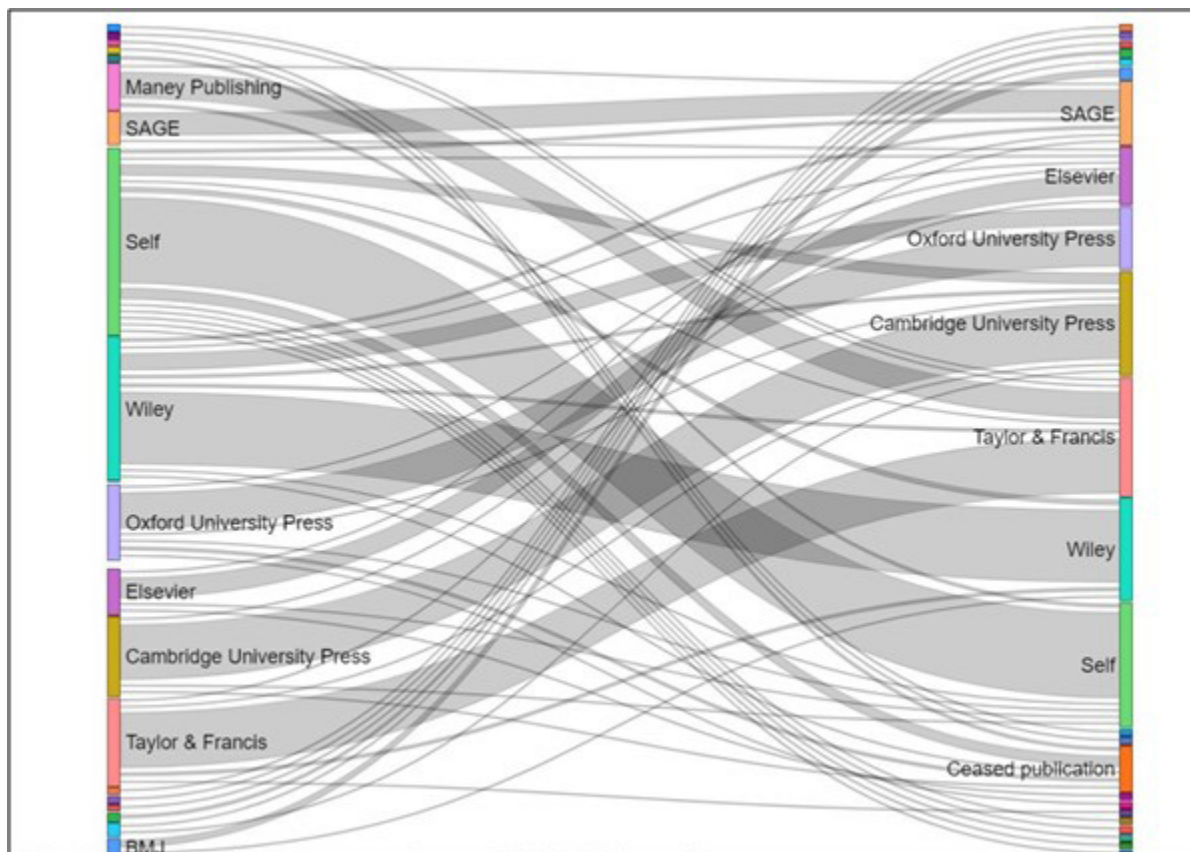


Figure 2. 2015 publishing partner vs. 2023 publishing partner for UK learned societies.

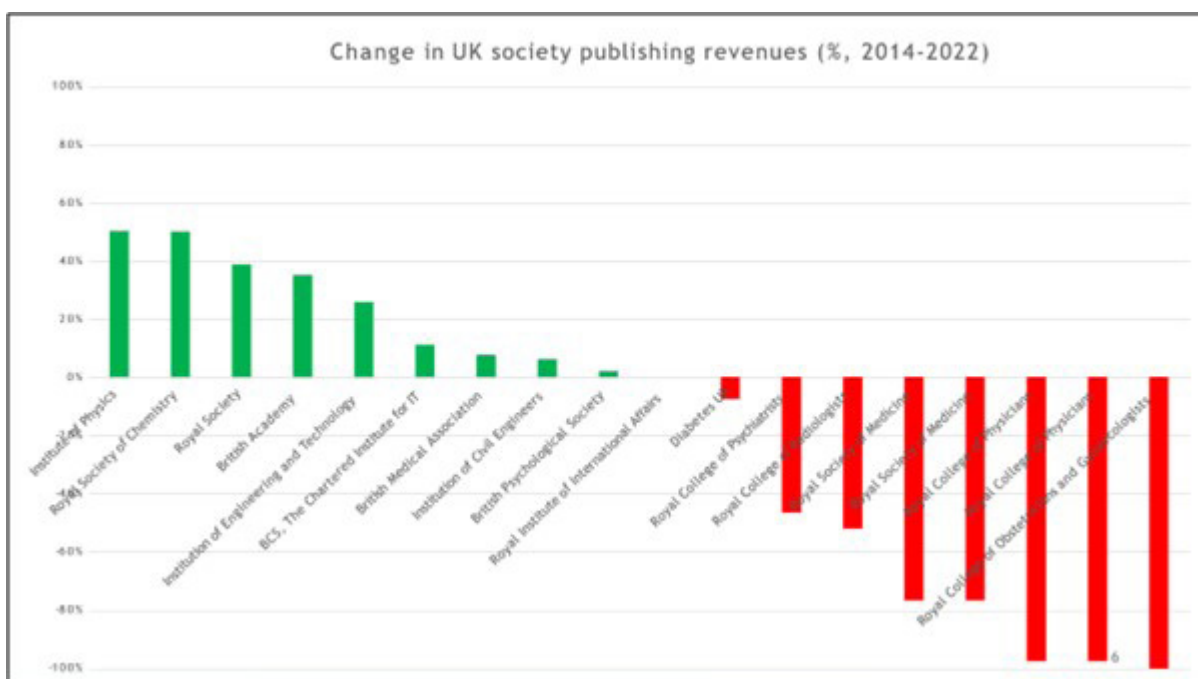


Figure 3. Percentage change in UK society publishing revenues, 2014–2022.

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2016, the Egyptian Knowledge Bank has provided citizens with access to major publishers' resources,¹⁴ in parallel with the QScience/Bloomsbury partnership initiated in Qatar.¹⁵ Also, KAUST OA initiatives in Saudi Arabia led to the establishment of the Saudi Digital Library, supporting read-and-publish agreements since 2018.¹⁶

Furthermore, Kardan discussed how these very setbacks have shaped Knowledge E's role in supporting the OA movement in MENA. Through the Knowledge E Foundation, their Philanthropic arm, they founded the Forum for Open Research in MENA to address the demand for education and policy development.¹⁷ Since then, they have hosted regional events in Egypt (2022), Abu Dhabi (2023, in partnership with UNESCO), and Doha, Qatar (2024), and monthly online community development activities. One of their key initiatives is an OA glossary in Arabic, designed to standardize OA terminology and clarify misunderstandings (e.g., "open access" as an equivalent of "free").¹⁸ Knowledge E has also supported the translation of "Think. Check. Submit." into Arabic and launched "Think. Check. Attend."^{19,20} to raise awareness about predatory conferences, with these resources also being translated into other regional languages to support MENA researchers.

As outlined in the last part of his talk, Kardan has long been interested in the costs of OA publishing, making affordability a critical concern. To address this, Knowledge E launched Zesty,²¹ a platform offering free access to OA content (supporting discoverability and accessibility) and affordable access to paywall content, which now boasts close to a million global users, acting as a sort of Netflix for scholarly literature. Zesty is just one of many initiatives demonstrating that significant developments are underway in the region—as confirmed, just 1 year after the webinar, with a notable milestone at King Fahd University National Library, where OA is now applied to both scholarly publications and Saudi Arabian heritage.²²

Updates and Key Takeaways

Closing this report are some key takeaways—much needed, given the 1-year gap since the webinar.

TAs have rapidly evolved as key tools in the shift toward OA, with significant developments since they started being introduced in 2019.²³ In just 5 years, TAs have become increasingly diversified, now encompassing a diverse array of contract types.²⁴ Their costs and value—particularly in light of the Coalition S decision to cease financial support by the end of 2024—remain topics of ongoing discussion.²⁵ However, if the numbers are anything to go by, the momentum behind TAs is undeniable. The ESAC Transformative Agreement Registry recently celebrated a major milestone, surpassing 1,000 agreements, with over 100 new entries added in just the first months of 2024 alone.²⁶ This surge, confirmed by

the STM OA Dashboard,²⁷ reflects a growing commitment within the scholarly community to embrace TAs as a viable path to expand OA, signaling a future where OA could soon become the norm rather than the exception. Ultimately, TAs can serve as enablers of broader missions, such as those aimed at strengthening research integrity.²⁸

Despite these promising trends, a key lesson from the webinar is clear: OA policies alone are not a silver bullet for the challenges facing the research community. Compliance with OA mandates has steadily increased, but it appears to have plateaued in recent years, suggesting that policy shifts need to be coupled with practical, systemic change. Furthermore, the adoption of alternative publishing models—such as the publish-review-curate model—remains sluggish, and open data availability continues to lag behind article compliance rates.

Although the BMGF has made significant strides in reducing APCs, the growing volume of publications has led to rising costs across the board. This reflects a broader pattern observed among learned societies, many of which are struggling to balance the financial pressures of OA with the need to maintain quality and sustainability in their operations.

Yet, there is cause for optimism. The growing emphasis on research integrity, along with a shared commitment to quality over quantity, is gaining traction as a beacon of hope for a more equitable and transparent publishing ecosystem. Likewise, collaboration will be key in moving forward. Funders, publishers, and organizations must work together to address the inherent challenges of TAs, including their costs and the need for fairer pricing models. As the BMGF and other key players continue to push for innovative approaches, it is clear that partnerships will play a pivotal role in advancing OA.

Regional variables must be considered too. While the MENA region has experienced slower adoption compared with the United States and Europe, significant progress is being made. The diverse challenges facing this region—mistrust of OA, a lack of infrastructure, and language barriers—highlight the need for country-specific strategies. By tailoring OA models to fit regional contexts, MENA countries can begin to unlock the full potential of OA.

And here, at last, is *equity*—at the heart of all these discussions and set to remain a central focus seen in CSE's 2024 Fall Virtual Symposium.²⁹ As the debate over the fairness of TAs and read-and-publish deals intensifies, achieving equitable access to scholarly content will demand ongoing dialogue, innovation, and global collaboration. As a result, TAs are likely to be impacted, especially now that a new equitable pricing framework has been announced.³⁰

Looking ahead to 2025, we can expect continued focus on policy development, partnership models, and cost-sharing strategies.

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Forging the Way Forward to Inclusive and Responsible Artificial Intelligence in Scholarly Publishing

Sumi Sexton, Chhavi Chauhan, and José E Rodríguez

With the recent Executive Order calling for “removing barriers to American leadership” in artificial intelligence (AI), development of AI and AI-enabled tools in the United States is expected to accelerate. However, in the absence of mandatory checks and balances, it is highly likely that the governance and the quality of output synthesized by generative AI tools may be compromised significantly, and the output may even lead to unintended consequences in the long run.

Like all other domains, the role of AI in scientific publishing is advancing rapidly, such that it is hard to imagine the future processes for writing, reviewing, and editing articles in 25 years, let alone the ways in which processes will change by the end of 2025. Regardless of AI implications on scholarly publishing now or in the distant future, we must ensure that AI is applied in a way that is safe and ethical and helps maintain the rigor and integrity in scholarship.¹⁻³ Of particular importance is navigating the influence of AI on diversity, equity, inclusion, antiracism, and accessibility (DEIA). Clinical studies have already reported severe (even detrimental) impact on patient populations when AI is widely adopted without validation.⁴ This problem is further magnified when AI is trained on limited datasets that are inherently exclusionary and then applied to marginalized groups.^{5,6}

Fast forward to the year 2050, when hopefully the publishing landscape includes affordable AI tools developed on robust datasets—empowering efficient editorial workflows, improved searchability, automated accurate language translation, possible alternative formats for both writers and readers, simpler bias detection, and enhanced transparency and accessibility—leading to fair treatment of authors and researchers globally. However, before we can envision this scenario, there are significant challenges to be addressed by multiple stakeholders along the way. These include the potential to create tools that perpetuate existing biases in the literature leading to wider health disparities in underserved groups, lack ethical considerations and cultural nuances, have limited regional access, and are cost prohibitive.^{7,8} A key challenge is navigating the shifting political climate which disincentivizes companies from considering some of these factors.

Currently available AI tools are limited in their ability to detect bias as they can only organize language the way it has been seen on the Internet. Because of the biases that exist even in the most objective of places (i.e., scientific journals), the promulgation of AI will only serve to perpetuate bias, instead of eliminating it.⁸ For example, medical algorithms that have inappropriately equated race with genetics leading to underuse of lifesaving antihypertensive drug classes and less frequent offering of vaginal birth after cesarean delivery in Black patients have come into question, yet these will continue to surface with use of AI.^{9,10} While humans are also not free of bias, it will be nearly impossible to truly eliminate all bias from the AI. AI can be taught to look for bias, but the complex patterns that show bias have yet to be discovered.

In addition to eliminating bias, providing accurate information is critical. The tendency for AI to confabulate/hallucinate is well known, so just imagine if these inaccuracies promote misplaced concepts, falsified data (propagating misinformation/disinformation), and fake papers that negatively impact groups that are already disadvantaged, severely compromising research integrity and eroding trust in scholarship.

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Aside from bias and accuracy, affordability and accessibility of AI tools will be essential to prevent increasing the current (and potentially widening) digital divide. For example, institutions, researchers, communities, cities, and countries across the globe with resources will be able to utilize tools to produce more publications at scale. Yet those in resource-limited settings, including those who may be researching and writing about marginalized populations, may not have access to the same tools, which can lead to less scholarly information being available from these groups. This may easily turn itself into a self-perpetuating vicious cycle of further marginalizing the already marginalized. The role of government infrastructures should also be considered, since some countries provide more access.

So, amid all the existing challenges and emerging chaos, what is the way forward? AI needs humans, like the movement toward DEIA needed humans, specifically with intersectional identities based upon diverse overlapping backgrounds. In the case of AI, these humans would have expertise in both bias and in coding, which is a rare combination, yet represents our best chance to continue to purge the bias that humans introduced into their large language models and other AI tools. Although some companies with the mission to remove bias from healthcare, like Equality AI, closed its doors, there are other larger companies like IBM's watsonx.governance which may have a better chance at addressing bias and promoting ethical practices. Given the lack of guardrails, however, keeping up with the rapid pace of innovation will remain an ongoing challenge.

As we consider AI's potential to exacerbate disparities and to perpetuate misinformation, we must return to the fact that AI is not sentient. It is a computer program. Computer programs do not do what you want them to do, they only do what you tell them to do, within the confines of the desired parameters. Therefore, the governing programs need to seek information from trusted sources and learn to weigh that information more heavily than information from the echo chambers of popular social media amplifying mis/disinformation. Published scholarly works on DEIA must be incorporated into AI algorithms. This is a possible future profession for DEIA leaders in the private sector as government defunding is fully implemented.

Scientific journals would be wise to band together and form partnerships with AI companies to ensure that an AI exists that can provide trusted scientific evidence without the bias and misinformation prevalent on the Internet today.¹¹ This could mitigate the spread of misinformation; however, it will not eliminate it. The COVID-19 pandemic taught us that even reputable journals can sometimes publish studies that are deeply flawed. WebMD, Doximity, and Medscape have developed AI tools that are already available to physicians, which can provide a credible alternative to those fueled by

other (mis)information. However, we must be careful not to trade one type of bias for another, as these collaborations are often heavily subsidized by the pharmaceutical industry.

To summarize, though it may seem daunting to develop, train, and operationalize ethical and responsible AI that is sustainable, scalable, inclusive, and performs optimally and as desired on all needed datasets while meeting all user needs, we must still strive to meet these needs in our own capacities. Only then can we achieve a bright future where responsible AI empowers humans to excel in their domains and enables the betterment of humankind.

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Love Me Through It: My Thoughts About the Future of Scientific Editing, Publishing, and Social Media, Written in the Year 2025

Jennifer Regala

When I first set out to write this column for the special issue of *Science Editor* on the Future of Scientific Editing and Publishing, I had an inside thought: “Thank you, dear Editor-in-Chief Jonathan Schultz, for making writing my column a wee bit easier this issue by providing me a list of simple, succinct questions to conform to an easy-to-digest template that our readers undoubtedly will enjoy more than my usual drivell!”

And then came 2025. Honestly, I could probably stop right there, and you, my beloved scholarly publishing colleagues, would undoubtedly understand the state of my jumbled brain. But friends. Jonathan sent me really important (yet not easy, after all) questions. And I must answer them. Love me through it as I attempt to make sense among chaos. And as you read my column and approach the scholarly publishing world in the coming days, months, and years, please don’t forget my personal motto: “It’s free to be nice and to comb your hair.” We are all going to need each other these next 25 years and beyond... I hope you read everything I have to say, but this message is the most important one I have to share today. Our community is precious. Don’t forget that.

Please realize that as I type these responses, I am frightened for the future of scholarly publishing. With presidential executive orders and the resulting turmoil

coming at us fast and furious, I urge us to cling to any and all means of proactive engagement with one another. The question is, which platform(s) do we make this engagement meaningful and effective? At the time of this writing, we are less than 60 days from a possible permanent closure of TikTok. I have witnessed most publishing professionals fleeing from the X platform. In early January, Mark Zuckerberg, Meta CEO, announced that Facebook and Instagram would no longer utilize third party fact-checking services.¹ A Bluesky year-in-review blog² shared that over 25.9 million users had joined the platform by the end of 2024. Bluesky retains the look and feel of Twitter from the good old days with some fun additional features, such as follower “starter packs.” And LinkedIn, meant to be a professional networking tool, has seen an uptick in conversation. I remain active on all of these platforms (except Facebook, which I have never used) so I can stay connected with all of you.

With the state of the current scholarly publishing social media state of the union in mind, let’s dive into the questions Jonathan asked me to answer about the platforms of our future.

Where do you see social media/ engagement in 2050 compared with where scientific publishing and editing are today? What new challenges do you anticipate will arise in the next 25 years?

Misinformation, disinformation, and trust will continue to be our biggest challenges in the next 25 years. If it’s hard to understand what is real now, can you imagine what the world will look like in 2050? That said, it is our collective responsibility to work together to disseminate the scholarly record in an honest, accessible, and reliable way. A challenge

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and an opportunity will be to find the best platforms to tell the stories of the research we publish. We must see ourselves as the guardians of the peer review process, and once important works are accepted, we must commit not only to publication deadlines but to using all means to showcase new findings. I believe in us and issue a call to action for us to band together to talk continuously about the best ways to ensure our authors' voices are heard.

What are you most hopeful about?

I am most excited about the potential of using artificial intelligence (AI) to enhance our social media experience in scholarly publishing. There will be tools we can depend on to curate and summarize research articles into concise, fact-checked social media posts, plain language summaries, press releases, and more. Once we can depend on these tools, imagine how easy it will be to share the contents of an entire issue with a global audience of widely varying interests. The time saved using these tools will then allow us, as scholarly publishing professionals, to pay attention to the interactions that count. If we can use AI to schedule the routine posts, and in 2050 I am predicting that we can easily prove the validity of such posts, then we as humans can spend even more time understanding each of our publications as the unique communities they are. Even in 2025, I am a scholarly publishing "elder," and I have spent many years of my career working to improve efficiencies to make all journals identical to one another. Well, guess what? Every single journal out there is as unique as a fingerprint. We are embracing those differences now. And with technology to take care of the mundane tasks, we will be able to prioritize the organic outreach and relationship building that will grow in importance as the foundation of a journal. A journal is a community, so let the AI do the boring stuff while we do the enriching and fun work of real, human bonding with our editors, readers, reviewers, and authors.

Imagine you are in 2050 looking back to today: What would you be the most disappointed to note has not changed?

I am not going to lie. The movement away from kindness, unity, and human decency in 2025 is debilitating and stifling. I will be eternally disappointed if in 2050, I look back and see things are the same or even worse.

My optimistic human spirit believes in collaboration over competition, always. However, given the capitalistic

approach in 2025 to social media, I cannot see that changing much in 2050. In fact, I encourage the thought of competitive platforms to allow users to pick and choose where they share their messages. That said, I hope scholarly publishing can settle on one place to communicate, much like the earlier days of Twitter used to be. I also believe that video capabilities will far exceed what we know now. And another fond hope is that a platform will step away from perfecting their algorithm and allow individuals to have complete control of their interactions without intervention or interference.

I cannot stress enough that we must believe in our scholarly publishing community. I pledge to make 2050 a welcoming and loving place and hope you all will join me in this call to action. And let's use every platform—social media and otherwise—to remain connected and resolute.

What possible development do you think most people are not anticipating?

There will be new social media platforms for sure. Some will mimic old favorites, while others will change communication via social media in ways we cannot begin to imagine. I will be following closely and sharing the news as I see it until Jonathan shows me the *Science Editor* door.

And I touch on AI above. I am fully committed to using these tools in the social media space to free up the people power we need to retain our community. These tools will become as commonplace to us as submission systems and journal platforms. Time is value, and these tools will equate to efforts better spent on warm human interaction.

As always, thank you to our beloved Editor-in-Chief, Jonathan Schultz, and please keep in touch. I welcome your thoughts on this article, social media, and anything else you want to talk about, scholarly publishing or otherwise. You can find me on X/Bluesky (@JenniferARegala), Instagram/Threads (@mommyjennyblog), email (Jennifer.Regala@WoltersKluwer.com), LinkedIn, or call/text (410-991-5857). I appreciate you all and look forward to our now-more-than-ever endeavors to make scholarly publishing better than when we found it.

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The Conscious Style Guide: A Flexible Approach to Language That Includes, Respects, and Empowers

Madison Brown

Book Review: *The Conscious Style Guide: A Flexible Approach to Language That Includes, Respects, and Empowers*. Karen Yin. New York: Little, Brown Spark; 2024. 281 pages. ISBN 978-0-316-47854-0.

What does conscious language mean to you? Karen Yin, author of *The Conscious Style Guide*, asserts that conscious language is “aware, mindful, and intentional about how we treat ourselves and others through language.”

Yin is the founder of the ConsciousStyleGuide.com,¹ a resource for anyone interested in learning more about implementing respectful language. *The Conscious Style Guide* packages Yin’s wealth of knowledge gained as an editor and writer into a practical resource filled with helpful examples. However, if you are expecting a list of dos and don’ts when it comes to the English language, this is not the book for you. Instead, Yin has created a book that can challenge a reader’s perception of language and that encourages critical thinking toward what we speak, write, and edit.

The Conscious Style Guide consists of five chapters: Prepare, Plan, Practice, Pause, and Persuade. In chapter 1, “Prepare,” Yin explains her philosophy of conscious language and introduces its 5 core components. These components are content, context, consequence, complexity, and compassion. Yin says inclusion of these components differentiates conscious language from other styles of thoughtful language.

Chapter 2, “Plan,” addresses implicit biases, bias activation, and how we can shift our perspectives. Yin says we can do this by questioning our motivations when using language and ultimately deferring to credible sources,

including journalism affinity groups, such as the National Association of Black Journalists and the Asian American Journalists Association.

In chapter 3, “Practice,” guidelines for implementing conscious language are presented. Here, Yin provides advice on how to ensure that one’s wording is not outdated, how to speak up when encountering ignorance, and which metaphors make sense depending on the situation. For example, did you know that statements that include everyone (for instance, “all lives matter”) can actually lead to exclusion? Yin artfully explains how this can occur and why the use of conscious language can avoid this situation.

Chapter 4, “Pause,” addresses common doubts involving conscious language and even provides step-by-step instructions for alleviating stress! Yin is certified in Emotional Freedom Technique (EFT), a relaxation method that employs tapping on the body’s acupressure points. *The Conscious Style Guide* walks readers through how to self-perform EFT in order to combat stress or anxiety that arises from working with language or dealing with people.

The book ends with chapter 5, “Persuade,” which teaches readers how to peacefully spread conscious language practices. For example, Yin identifies ways that readers can appeal to others’ interests and priorities. Yin encourages us to remind ourselves and others that conscious language “liberates instead of limits.”

Yin states, “This book is an invitation to think and question, not to perform.” She indicates that adopting conscious language not only promotes compassion and equity but also keeps us continually evolving as people. Whether science editors will be updating language guidelines for their publications, editing text that talks about people, striving to communicate respectfully with authors or others, or just trying to develop further as thoughtful members of the profession, *The Conscious Style Guide* is an excellent addition to their bookshelves.

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