Collaborating with early career researchers to enhance the future of scholarly communication: A guide for publishers

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Abstract

The scholarly publishing system is adapting to many changes including open access and open data mandates, and new technologies, including artificial intelligence. Members of the research and publishing communities are working to establish a more equitable, fair, and rigorous system that serves researchers' evolving needs. Early career researchers (ECRs) are drivers of change, and publishers may wonder why and how they should involve ECRs in shaping the future of scholarly publishing. We held a virtual unconference to explore this issue with publishers and ECRs who were working to improve publishing. Some participants sought to improve peer reviewer or editor performance, whereas others sought to improve or reform the publishing system itself. Strategies for achieving these goals included peer review programs, editorial programs, ECR-led journals, ECR boards and committee representatives, and other ECR-initiated activities. ECRs particularly wanted to see three things improved: 1) Sharing research outputs other than publications, 2) Addressing technological limitations to create systems that meet the research community's needs and facilitate knowledge advancement, and 3) Fostering diversity, equity, inclusion and accessibility. We offer tips for publishers on how to collaborate with ECRs to enhance scholarly publishing, appeal to and learn from younger researchers, and better meet researchers' needs.

Introduction

Publishers are facing a number of challenges, including funder open access mandates (Else, 2021; Tollefson and Van Noorden, 2022, https://www.coalition-s.org/why-plan-s/, https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-Access-Memo.pdf), the proliferation of paper mills (https://www.science.org/content/article/fake-scientific-papers-are-alarmingly-common), and increasing use of artificial intelligence (Carobene et al., 2024). Research assessment reform initiatives (https://coara.eu/) and new infrastructures and approaches are also changing the types of outputs that researchers share, and where, when, and how they choose to share them. The use of preprints, for example, has grown exponentially over the last 30 years (Xie et al., 2021). Requirements (https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-013.html, https://www.dfg.de/resource/blob/172098/b08fcad16f1ff5ddca967f1ebde3a8c3/guidelines-research-data-data.pdf) and recommendations (https://www.go-fair.org/fair-principles/, Batista Leite, S. et al., 2024) that encourage sharing of other research outputs, like protocols, data, and code, are raising questions about when and how these outputs should be assessed.

While the scholarly publishing system plays a vital role in evaluating and disseminating research, many researchers and other stakeholders are concerned that this system does not meet the research community's evolving needs. Common concerns include high article processing charges (APCs) despite the low cost of online publishing (Borrego, 2023; Jain et al., 2021; The Lancet Planetary Health, 2022), subscription (https://opusproject.eu/openscience-news/the-hidden-cost-of-subscriptions-a-barrier-to-open-access-for-researchers-and-the-public/, Gorelick and Li, 2021) or author payment models that limit access, the deleterious impact of systemic biases (Rouan et al., 2021), and the need to incorporate new technologies and strategies to improve research dissemination. Researchers have also highlighted problems with peer review, including inconsistencies in reviews (Bornmann et al., 2010) and reliance on volunteer labor (Aczel et al., 2021).

Some members of the research and publishing communities have been working to create a more equitable and rigorous system that aligns with researchers' needs. Co-creating solutions with researchers may give publishers a competitive advantage. Early career researchers (ECRs) are crucial to this conversation for many reasons (Box 1). The definition of ECRs differs across fields, institutions, and countries, but may include graduate students, post-doctoral researchers, and investigators who have recently started their own research groups. ECRs are important drivers of change, having founded, led, evaluated, and contributed to initiatives to improve various aspects of scholarly publishing. ECR-led activities include establishing hands-on peer review training courses that are integrated into the journal peer review process (e.g., Rohmann et al., 2022), developing new publishing platforms that allow researchers to share and connect outputs created throughout the research process (e.g., https://www.researchequals.com), and establishing new societies, open access journals and preprint servers (e.g., Society for Transparency, Openness, and Replication in Kinesiology, STORK). ECRs have also collaborated with journals to reform activities (e.g., eLife's Early Career Advisory Group - Mehta et al., 2020; Urban et al., 2022). Activities like these showcase

ECRs' contributions to improving or reforming scholarly publishing, while illustrating the potential impact of collaborations between ECRs and publishers.

In this guide for publishers, we explain why it is important to integrate ECRs into the publishing process in roles beyond authorship and to engage ECRs in improving and reforming the publishing system (Box 2). We also highlight three aspects of the publishing system that ECRs would particularly like to see improved. Finally, we offer tips for publishers who wish to collaborate with ECRs to improve scholarly communication. This guide emerged from a global virtual unconference where ECRs, academic editors, and publishing professionals explored opportunities to improve and reform scholarly publishing.

Event Format

In January 2023, 94 participants across 10 time zones (Figure S1) participated in a virtual unconference (S1 text). Two-thirds of participants were researchers. Most were ECRs, mainly from the life sciences, who were working to improve publishing or engaged in publishing in roles beyond authorship and peer review. This included ECRs who were editors, or members of early career advisory groups, who led student-run journals, had created publishing platforms or peer review training programs, or participated in preprint review programs. Some mid-career or senior researchers who were academic editors also participated. The remaining participants represented publishers. Publishing representatives were affiliated with large and small academic publishers, society-led publishers, student-led journals, and independent platforms for sharing research outputs other than papers. The unconference consisted of two days of intensive discussions, through virtual networking events, virtual meetings, webinars, and asynchronous written conversations on an online discussion board. This unconference format has been introduced previously (Holman et al., 2021). These discussions continued during the in-person Academic Publishing in Europe 2023 conference and its satellite event "At the Crossroads: Early Career Researchers and Scholarly Publishers" (S1 text).

Box 1: Why should ECRs be a part of shaping the future of scholarly publishing?

- **ECRs are the largest and most diverse group of researchers** (https://scholarlykitchen.sspnet.org/2014/10/06/guest-post-phill-jones-on-the-changing-role-of-the-postdoc-and-why-publishers-should-care/, https://www.interacademies.org/sites/default/files/publication/gya-glosys-report-webversion.pdf). ECRs are major producers and consumers of research outputs, including publications. As future research leaders, ECRs should shape the system that they will inherit. ECRs' expertise is also invaluable in leveling the playing field to create a scholarly publishing system that works for everyone. ECRs are more diverse than senior investigators, with respect to the social constructs of ethnicity and race, gender identity, socioeconomic status, sexual orientation, language, and nationality (Heggeness et al.,

2017; Nikaj et al., 2018). They may experience systemic bias due to these factors and their career stage (Huber et al., 2022; Receveur et al., 2024). Co-creating solutions with ECRs can help publishers reach broader communities, connect with the next generation of authors, reviewers and editors, and remain competitive in the scholarly communication system of the future.

- **ECRs have valuable expertise.** ECRs are in their formative years of building a research skill set and toolkit, and therefore are more likely to have fresh skills, hands-on experience, and awareness of implementation challenges than more experienced academics who no longer routinely collect and analyze data. This includes training and experience in good scientific practices, data-driven research, new scholarly communication practices, such as preprints or open science (Sarabipour et al., 2019; Wolf et al., 2021), and interactive digital communication formats throughout the research lifecycle (e.g., reproducible workflows, videos, podcasts). Publishers that only engage mid-career and senior researchers place themselves at a competitive disadvantage. ECRs can provide crucial insights into new developments that are shaping the research community's evolving needs, while creating opportunities to enhance the future of publishing.

- **ECRs can provide concrete advice on how to implement changes that meet the needs of the wider research community.** ECRs can provide publishers with experience-based guidance on developing and evaluating inclusive, practical programs and policies, in addition to highlighting problems with existing practices. Co-designing solutions with early input from ECRs benefits both parties. Publishers get valuable advice on how to meet the research community's needs. ECRs learn about the limitations of the complex publishing system and the feasibility of proposed solutions.

Box 2: Definitions

Scholarly publishing process: The process that papers undergo to be published in a peer reviewed journal, including manuscript submission, editorial checks, peer review, editorial decision, revision, and rejection or publication. This may also include optional steps like posting a preprint or sharing important outputs such as protocols, data, and code on public repositories.

Publishing infrastructure: The technical systems used to implement the publication process and index research outputs. This includes software used to handle all aspects of the scholarly publishing process, websites or platforms containing published papers, repositories containing other research products that may be cited in papers (e.g., protocols, data, code), systems to assign and manage persistent identifiers, and search engines used to discover published research outputs.

Scholarly publishing system: The combination of the scholarly publishing process, publishing infrastructure, and the people and organizations involved in scholarly publishing. People include authors, peer reviewers, editors, and publishing staff. Organizations include for-profit and non-

profit scholarly publishers, repositories, publishing infrastructure providers, and indexing services.

The spectrum of approaches to change

ECRs, editors, and publishing professionals approach change differently (Figure 1). Some individuals seek to improve the existing publishing process by training and integrating ECRs into essential roles, such as peer reviewer or editor. Others seek to reform the system itself, through evolutionary or revolutionary approaches. When using evolutionary approaches, iterative changes gradually accumulate to improve the publishing system. Revolutionary approaches seek transformative change or a complete redesign of the publishing system. Evolutionary and revolutionary approaches can be applied to improve a single aspect of the publishing system, such as peer review or diversity, equity, and inclusiveness, or the entire system.

Each approach has strengths and weaknesses. Proponents of training and integration argue that expanding the pool of qualified researchers will improve the quality of feedback provided by reviewers and editors within the existing publishing process. However, these programs will only lead to widespread change if they deliver effective skill development on a very large scale. This includes reaching the subset of mid-career and senior researchers who were never formally trained and may lack important skills. Those who favor evolutionary approaches may argue that improvements to the existing system are more feasible than revolutionary approaches, given the complexity and constraints of the publishing system. Furthermore, iterative improvements to many aspects of the publishing system may ultimately lead to transformative change. In contrast, those who favor revolution might argue that iterative changes are slow, fail to consider how different parts of the system interact, and will not address crucial limitations of the current system. Co-creating solutions with ECRs and other stakeholders from across the spectrum of approaches summarized in Figure 1 may lead to a more comprehensive and nuanced understanding of the limitations of the current system, leading to innovative, feasible solutions.
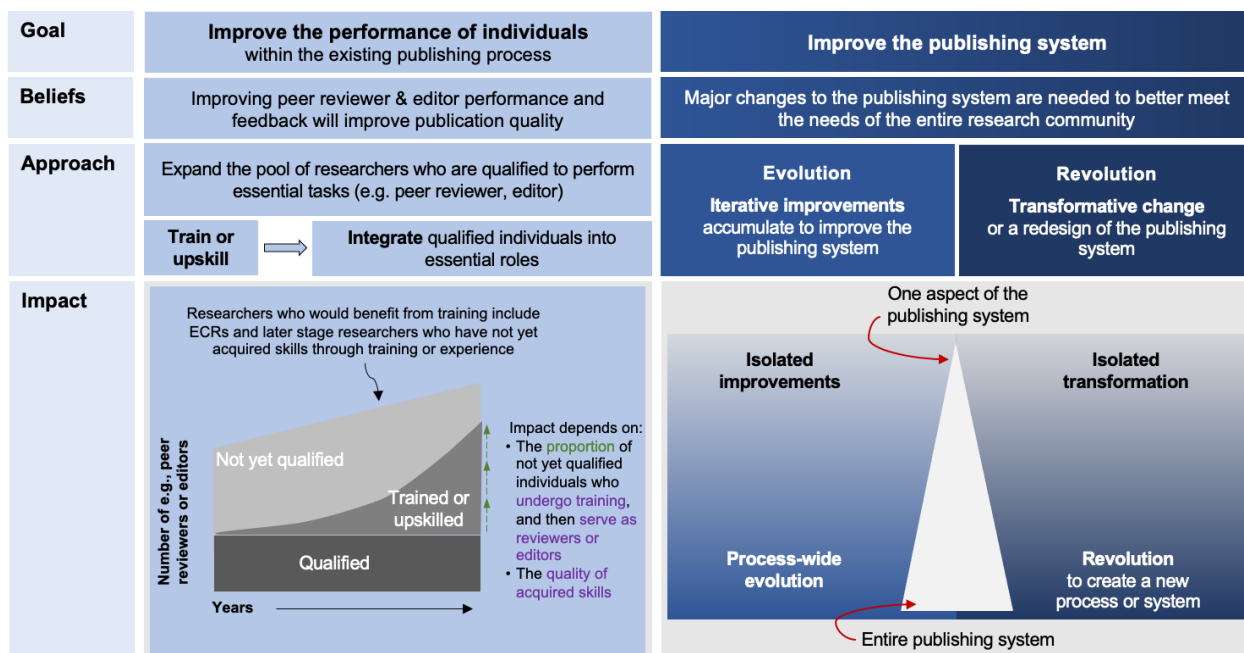
Figure 1: Approaches to improve scholarly publishing

The figure highlights differences in belief, approach, and the potential impact of approaches that seek to improve the performance of individuals within the existing publishing process, vs. those that seek to improve the scholarly publishing system. Activities that focus on improving the performance of individuals typically seek to improve the quality of reviewer and editor feedback.

How can ECRs shape the future of scholarly communication?

Programs and activities that facilitate collaboration between publishers and ECRs fall into five categories: peer review, editorial roles, ECR-led journals or special issues, boards or committees, and other ECR-led initiatives (Table 1).

Table 1: ECR-focused programs and activities to improve publishing

Category	Program or activity	Improve the performance of individuals within the existing publishing process		Reform the publishing system	
		Train	**Integrate**	**Evolution (iterative change)**	**Revolution (transformative change)**
Peer review	Training programs - theoretical	✓			
	Training programs – hands on experience	✓	✓		
	(ECR) peer reviewer programs*		✓		
	Crowd preprint review	✓	✓		
	Preprint recommendation programs	✓	✓		
Editors	Editorial assistant internship	✓	✓		
	ECR editor program	✓	✓		
	ECR editors		✓		
ECR-led journals or issues	ECR-led journals	✓	✓	✓	✓
	Mentored ECR-led issues	✓	✓		
Boards and committees	ECR representatives on committees	✓		✓	✓
	ECR advisory boards	✓		✓	✓
	Innovations advisor programs		✓	✓	✓
Other ECR-led activities	Partner with or support ECRs leading innovative initiatives to improve publishing			✓	✓

*Peer reviewer programs refer to programs that invite new reviewers to review papers. Abbreviation: ECR, early career researcher.

Peer review

Peer review programs may provide an entry point for ECRs and others who want to start reviewing papers, while preparing ECRs for more substantive roles. Publishers should not limit ECR engagement to peer review, as ECRs have a much greater potential to improve publishing. Often publishers don't use this potential effectively.

Eliminating ghost reviewing: Some publishers have implemented measures to limit unacknowledged "ghost-reviewing", where a more senior scientist submits a review that was entirely or partially prepared by someone else, who is often an ECR (McDowell et al., 2021, 2019). Reviewers are asked to name other individuals, including ECRs, who contributed to the review. Editors can invite these experienced ECRs to review future papers.

Hands-on peer review training: While many organizations offer peer review courses (e.g., Willis et al., 2022), these programs are often theoretical. ECRs were particularly interested in programs that combine theory with real-life experience. In the Peerspectives course (Rohmann et al., 2022), for example, ECRs work with an editor as a mentor to complete collaborative group peer reviews for papers submitted to partner journals. These open reviews are used in the peer review process. The group discusses the other reviewers' reports and the editors' decision, and listens to an editorial board meeting to hear how reviewers' comments inform editorial decision-making. Group training allows ECRs to focus on parts of the paper that are most relevant to their expertise, while learning from others' comments. In undergraduate programs, group training helps participants to understand the peer review process, improves peer review quality, and boosts a sense of belonging in the scientific community (Otto et al., 2023).

ECR peer reviewer programs: Peer review training programs may serve as an entry point for to programs that invite ECRs to review papers. Program organizers must ensure that editors know about and invite ECRs to review papers in the ECRs area of expertise. ECR reviewers can provide specialized practical and technical skills (e.g., Nüst and Eglen, 2021).

Crowd preprint review: Many researchers collaboratively review a preprint, then publicly share their review. Participants gain hands-on experience, while learning from others with different expertise. Locally organized preprint journal clubs, and larger organizations (e.g., preLights, PREreview, ASAPbio Crowd Preprint Review initiative) use this model.

Preprint recommendation programs: At Proceedings B, ECRs can recommend preprints that they think should be invited to submit to the journal (Neiman et al., 2021).A senior editor reviews these suggestions, decides whether to invite the preprint authors to submit the paper, and provides ECRs with feedback on their suggestions.

Editor roles and programs
Academic editors are typically mid-career and senior researchers who have published peer reviewed papers, have peer review expertise and a broad knowledge of their field. Training and mentorship programs may prepare ECRs to enter these roles earlier in their careers.

Editor programs: These programs offer training for editors who are ECRs. Some programs pair new editors with an established editor as a mentor (https://www.ersnet.org/news-and-features/news/meet-the-editors-early-career-editor-mentoring-programme/, https://academic.oup.com/ijcoms/article/2/1/lyac007/6612939,https://www.ices.dk/news-and-events/news-archive/news/Pages/IJMSmentor.aspx). Training or mentorship should address common situations that editors may encounter and share tips, tricks, and lessons learned. Technical training on how to use the manuscript submission system is necessary, but not sufficient.

Editorial assistant positions: ECRs working in editorial assistant positions obtain training and mentorship from editors, while providing editorial support (e.g., https://cdnsciencepub.com/do/10.1139/news.2022.10.11/abs/).

ECR-led journals and mentored issues

ECR-led journals: ECR-led journals provide ECRs with hands-on experience running journals, while allowing students to publish peer-reviewed papers presenting thesis research. ECRs gain experience reviewing, editing, and coordinating the publication process. ECR-led journals can also experiment with new forms of publication and peer review. Examples include the Journal of the Student Network for Open Science (https://s-nos.org/journal/) and the Journal of European Psychology Students (https://jeps.efpsa.org/).

Mentored ECR-led issues: ECRs gain experience with editorial responsibilities and all phases of the publishing process by producing a special issue, with mentorship from experienced editors and journal staff. These should not be confused with non-mentored special issues that use ECRs and other researchers to attract content, thereby increasing publisher profits. Non-mentored special issues may damage the guest editors' reputation if content quality or publisher editorial practice is poor (https://scholarlykitchen.sspnet.org/2023/03/30/guest-post-of-special-issues-and-journal-purges/). Mentored ECR-led issues may be more appealing to some ECRs than editor positions, as ECRs make a short-term commitment to develop skills, without assuming a long-term responsibility.

Boards and committees

Advisory boards and committees: Some publishers have ECR advisory boards to provide input on policy or operational changes, new or existing programs, or other topics related to improving scholarly publishing. ECR advisory boards must be integrated into decision-making processes and regularly interact with senior editors and publishing staff. Alternatively, publishers may add ECR representatives to committees. Previous work addresses the tradeoffs between

advisory boards and committees (Kent et al., 2022) and shares best practices (Holman et al., 2022).

Innovations advisor program: Most editors are mid-career or senior researchers; yet, ECRs often have more expertise with new techniques, digital and interactive dissemination formats, and open science practices. Innovations advisor programs would allow ECRs to provide publishers with advice on how to implement new practices within the publications process. Activities might include introducing changes suggested by ECRs or seeking expert input on planned changes or emerging topics (e.g., whether or how to adjust reviewing practices for papers that share open data).

Other ECR-led initiatives to improve publishing: ECRs have also initiated activities beyond the categories described above. Examples include developing publishing platforms that allow researchers to share and connect various research outputs (e.g., https://www.researchequals.com), creating automated tools to screen preprints for rainbow colormaps, which aren't colorblind safe or perceptually uniform (https://elifesciences.org/labs/c2292989/jetfighter-towards-figure-accuracy-and-accessibility), and developing a podcast format for sharing abridged and annotated audiobook-style recordings of research papers (Harrison and Loring, 2023). Publishers may seek out ECRs working on topics aligned with the publishers' priorities for change.

Priorities for change

ECRs participating in the event highlighted three aspects of the publishing system that they would particularly like to see improved. These themes are presented below; however, publishers should consult with their own ECR communities to identify priorities, explore solutions, or evaluate the impact and limitations of existing practices. Consulting with ECRs can help publishers to gain a competitive advantage by meeting the research community's needs.

Facilitate sharing, reviewing, and publishing of different types of research outputs

ECRs who participated in the event wanted to share more than traditional publications. Preregistrations, registered reports, study protocols, reusable step-by-step protocols (Batista Leite, S. et al., 2024), data (Wilkinson et al., 2016), code (Baker et al., 2024), software (Chue Hong et al., 2021),and tools are essential for reproducibility, reuse, and knowledge advancement. Reform initiatives such as CoARA emphasize the importance of considering all outputs in research assessment (https://coara.eu) and some funders consider other outputs when assessing researchers (https://www.dfg.de/en/news/news-topics/announcements-proposals/2022/info-wissenschaft-22-61). As other outputs are integrated into research assessment, researchers will increasingly seek opportunities to share and link these other outputs in publications.

The research community needs a publishing system that facilitates sharing of different types of outputs, builds openly accessible connections between related outputs, and facilitates reuse. Publishers can support these needs by making it easy for researchers to cite and link out to

outputs that are shared in repositories and including links to cited outputs in open article metadata (https://barcelona-declaration.org/). This is essential to make interconnected outputs findable (Weissgerber et al., 2024). Publishers can also mandate the use of persistent identifiers and standard citation formats, developed by the research community, for non-traditional research outputs so that the research community can track reuse. Additionally, publishers can require cited materials to be shared with persistent identifiers on repositories that have long-term preservation plans to ensure future accessibility.

Address technological limitations to create submission, publishing, and indexing systems that meet the research community's needs

Updating proprietary, legacy submission, publishing, and indexing systems is critical for modern science. Researchers participating in the event shared several cases where technical limitations prevented publishers from meeting the research community's needs (S1 text). These include an inability to integrate code reviewers into editorial submission software to allow rapid, anonymous discussion between code reviewers and authors, and an inability to adapt article websites to display abstracts and other information in different languages (e.g., Amano et al., 2023b, 2023a; Kent et al., 2022). Researchers also noted the prohibitively high cost and technical challenges of integrating new features into online submission systems, such as automated tools to screen submitted papers for common problems or beneficial practices (Schulz et al., 2022). Furthermore, many articles are only offered as PDFs. This makes it difficult to search for or access machine actionable information, especially in tables and figures. Solving the problems described above requires modern systems that can be easily, sustainably, and inexpensively adapted to the research community's needs. S1 text provides further information on problems and potential solutions.

Foster diversity, equity, inclusion, and accessibility

Researchers, and especially ECRs, who are a diverse cohort, need a publishing system that fosters diversity, equity, and inclusion (DEI), instead of exacerbating existing inequalities. Recent discussions have expanded DEI to include accessibility (DEIA) (Wells Ajinkya et al., 2023), which is crucial to scholarly publishing. S1 text highlights some of the many actions that publishers could take to address DEIA. Publishers should consult with ECRs and other researchers to identify community priorities and explore solutions. Many publishers are already taking action on aspects of DEIA, including expanding the diversity of editorial boards, and reduced subscription costs for researchers in countries with comparatively limited research funding, supporting the posting of preprints before submission to their journals, fostering multilingualism (http://gigasciencejournal.com/blog/how-to-publish-multilingual-articles/, https://info.africarxiv.org/fostering-multilingualism-in-african-scholarship-through-digital-tools/), and introducing policies to stop parachute science (Odeny and Bosurgi, 2022). Consulting with ECRs will help publishers to identify the strengths and limitations of existing approaches and explore novel solutions.

Strategies for collaborating with ECRs

We recommend that publishers use the strategies outlined below when developing new programs or refining existing programs to improve the publishing system.

Getting started

- **Align program structure with goals:** Existing formats have been described above and new formats may be developed to address unmet needs. Consult ECRs to learn what types of opportunities they would like, and how to structure programs or opportunities to facilitate co-creation, which benefits ECRs and publishers. Ask those leading programs that one might like to emulate to share tips, lessons learned, and materials.

- **Offer ECRs career development opportunities**: ECRs face pressure to meet career milestones, leaving limited time for career development. Implement programs that allow ECRs to progress to independent roles within the publishing system at an earlier career stage. Specify how participating will benefit ECRs and provide evidence to support these claims.

- **Engage ECRs with diverse perspectives, experiences, and knowledge:** ECRs are diverse in many ways, including field of research, geographic location, career stage, gender, socioeconomic status, and the social constructs of race and ethnicity. Engage groups of ECRs to learn from these diverse perspectives.

- **Consider scalability:** Choose solutions that can be implemented at scale. While potential solutions may be developed and tested on a small scale, they must be dramatically scaled up to have a meaningful impact across the publisher's portfolio, or the entire publishing system. Solutions that aren't scalable are unlikely to lead to systemic change.

Engaging ECRs

- **Clearly specify program goals, deliverables, and expected impact**: ECRs who dedicate time to an activity want to know that their work will have a meaningful impact. Clearly articulate the program's goals and ensure that ECRs are provided with the resources and decision-making power needed to achieve these goals. Explain how specific programs can lead to changes in publishing practices and how ECR's engagement will be publicly documented. For existing programs, provide examples of improvements introduced as a result of the program. Be flexible when thinking about specific deliverables and expected impact. Both publishers' and ECRs' perspectives on the pre-specified goals will evolve through collaborative discussion, and this may alter the program's trajectory.

Program advertisements should also provide specific information, such as the estimated time commitment, program duration, level of expertise sought and monetary or other types of compensation. This allows ECRs to select programs or initiatives that are relevant to them and align with their interests, motivation, schedules and needs. When specifying the level of expertise, focus on the necessary skills, rather than career stage. ECRs at the same career stage have different skills due to experiences prior to or outside of academia, training opportunities, participation in activities to improve scholarly publishing, or variations between fields, programs, and countries.

- **Inform ECRs about readiness for change:** This includes whether there is readiness to improve the performance of individuals within the existing system, or improve the publishing system itself. Specify which aspects of the publishing system you seek to improve. This will help ECRs to identify publishers whose interests align with theirs and assess the likelihood that ECR participation will have a meaningful impact.

- **Use open applications, instead of recruiting through established networks**: Advertise events, programs, and open positions through different channels to reach as many ECRs as possible. Strategies include partnering with student organizations, scientific societies, organizations supporting underrepresented minorities, contacting authors, and using various social media outlets. Avoid recruiting ECRs through editors or contacts, as this may amplify existing inequalities by engaging ECRs from well-funded research groups whose principal investigators are already well connected in the publishing system.

- **Advertise that positions are open and welcoming to ECRs when soliciting applications**: ECRs may otherwise assume that they are not eligible for positions typically held by senior or mid-career scientists.

- **Invite expert ECRs**: Search online to identify ECRs who are working on the topic that you wish to develop. Look for relevant publications, blog posts, and social media posts. Send personalized invitations to invite expert ECRs to apply or participate.

- **Involve ECRs in the selection process and take measures to reduce systemic bias:** These measures are important to capture diverse perspectives and reduce existing inequalities. Access to opportunities varies with factors such as gender, nationality, ethnicity, and funding available for research in the researcher's country, institution, and research group. Many factors that are traditionally interpreted as indicators of merit are also markers of privilege (e.g., ability to pay high APCs to publish in high impact journals). Level the playing field by co-developing a selection system that reduces bias, with ECRs.

Implementation

- **Reduce barriers to participation**: Identify barriers that may prevent ECRs from participating. Explore hybrid formats and different forms of online interactions (e.g., live, synchronous vs. written, asynchronous), provide travel funding, and don't charge participation fees. Record meetings or events and make them freely available afterwards to enable engagement across time zones. Implement protected time programs to support ECRs actively engaged in enhancing the future of scholarly communication.

- **Provide compensation**: ECRs typically have very limited funding. Providing monetary compensation for their time and expertise recognizes the value of ECRs' work, while creating opportunities for those with limited resources who could not participate otherwise. If mid-career and senior researchers are compensated for performing similar tasks, ECRs must also be compensated.

- **Create an inclusive and safe environment**: Don't rely on ECRs to increase diversity. Diversity should be reflected at all levels and in all roles in scholarly publishing. Include more than one ECR on committees to ensure a range of perspectives, while providing peer support. Provide an ombudsperson who is aware of ECR-related issues, and who can provide support if issues arise.

- **Avoid including ECR designations in role titles**: Titles such as "ECR Editor" may suggest that the work done by ECRs is less valuable than that of more senior researchers and that ECRs lack expertise and experience for the position. This may cause others to underestimate ECRs' contributions.

- **Offer ECRs engaged in programs a visible platform to share their perspectives and activities**: This may include writing perspectives articles, commentaries, or blog posts, offering webinars, or organizing workshops. Offer ECRs the same platforms as editors and mid-career or senior scientists.

- **Give ECRs decision-making power.** Counteract established power dynamics and integrate ECRs into the decision-making process. Trained ECRs should have the same responsibilities and authority (e.g., voting rights) as more senior scientists.

- **Provide certificates or reference letters**: This helps ECRs to establish their expertise and contributions when applying for future positions.

- **Provide training and mentorship when needed**: Mentorship and training are useful for many roles, such as peer reviewer or editor.

Learn and adapt

- **Solicit regular feedback**: Seek feedback from ECRs who are involved in publisher activities to collaboratively evaluate effective practices, identify challenges, and explore opportunities for improvement.

- **Adapt by incorporating feedback**: This might include adjusting program goals in accordance with changing circumstances and the needs of the ECRs and publishers or taking steps to improve the existing program.

Limitations

The virtual unconference that led to this paper has several limitations. Many experiences and ideas shared during the event are based on practices and roles from the life sciences. Discussion generally focused on research papers, rather than books or monographs. Many participants were based in Western Europe and North America. Most participants were invited by organizers; however, a broad search strategy was applied to identify ECRs and publishers with ECR-focused programs outside of the organizers' networks (S1 text).

Conclusions

Scholarly publishing is facing a variety of challenges due to changes in good research practice, new technologies and open access regulations. Researchers are increasingly recognizing the need for a more equitable, fair, and rigorous publishing system that adapts to serve the research community's evolving needs. ECRs are crucial to this conversation, as they bring in diverse perspectives, and have founded, led or are actively engaged in programs and activities to improve or reform publishing. Engaging with ECRs can help publishers to adapt, as ECRs are at the forefront of emerging trends in good research practice, technological advancement, and scientific communication. Publishers should identify opportunities to integrate ECRs into the publishing system in roles beyond authorship, including as peer reviewers and editors. Publishers should also consult with ECRs and other stakeholders to identify priorities for change. This may include improving the performance of individuals within the existing publishing process, or improving the publishing system itself. When working with ECRs to shape the future of scholarly publishing, publishers should create an inclusive environment, remove barriers to participation to reduce existing inequalities, ensure that programs are designed to have a meaningful impact on scholarly publishing, and provide ECRs with the resources, support, and decision-making power needed to achieve program goals.

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Collaborating with early career researchers to enhance the future of scholarly communication: A guide for publishers

Event format

Detailed methodology of the virtual brainstorming event

The main event organizers (FK, VK, TLW) invited participants to attend the virtual brainstorming on "The future of scholarly communication – A virtual brainstorming discussion between early career researchers and scientific publishers" in January 2023.

Invitations were primarily issued to early and mid-career researchers and initiatives worldwide actively engaged in improving scholarly communication and to academic editors and publishing professionals, many of whom were engaged in programs to increase ECR involvement in publishing. Participants were identified through extensive website and social media searches, personal recommendations (snowballing), published work on this topic, and existing contacts.

This virtual brainstorming event consisted of four components: 1. two virtual networking sessions prior to the brainstorm, 2. the asynchronous written brainstorming using an online discussion board (Slack), 3. live, small group discussions in virtual meetings on selected topics related to the future of scholarly communication, 4. two live webinar sessions featuring Lightning Talks and PechaKuchas presented by event participants. The format of this virtual, asynchronous unconference has been described in detail elsewhere (Holman et al., 2021).

Over two days, 94 participants from 20 different countries joined the discussions during the event (Figure S1). Participation was defined as writing in one or more discussion channels, attending an open space session, presenting at a webinar session and/or following the conversations by reading.

The asynchronous discussion was structured through guiding questions provided by the organizers at the start of the event:

1. What factors are most important to you in deciding when, where and how to share or publish your work?

2. What barriers do ECRs face when publishing their work? How do these barriers differ for ECRs from communities that are marginalized or underrepresented in research? How can we address these barriers?

3. What complementary research outputs might you like to share, beyond publications (e.g., pre-registration documents, open protocols, open data, open code)? What obstacles do you face when attempting to share these materials in the current system? How might we adapt the publishing system to overcome these obstacles?

4. How can we make research outputs more inclusive and accessible to a broader audience? What groups face barriers to access or understanding, and how can we reduce these barriers?

5. What norms in the research community make it challenging to test or adopt new approaches? How can we shift these norms?

6. What role(s) do you think that ECRs should play in the publications process, beyond submitting papers as authors? How can publishers involve early career researchers in these roles?

7. What change would you most like to see in scholarly communication and scientific publishing? How might you implement this change?

In-depth discussions included live, small group conversations in virtual meetings and asynchronous written conversations on the online discussion platform Slack.

A collection of resources (Kohrs et al., 2023) were shared after the virtual brainstorming event, including a brief summary of the major themes discussed, resources shared during the event, presentation slides, and lightening talk recordings (https://www.youtube.com/playlist?list=PLpplPc8GgXz7H91egZWLrE4Cdcl0PVe-G).

Discussions at the Academic Publishing in Europe 2023 conference: Discussions that were initiated during the virtual brainstorming event continued during the Academic Publishing in Europe 2023 conference and its satellite event "At the Crossroads: Early Career Researchers and Scholarly Publishers", held in Berlin. During this pre-conference session, unconference attendees located in Berlin and other engaged ECRs and publishers met in person to discuss topics selected by participants, including peer review, non-traditional research outputs, as well as innovations and new technologies. Major discussion points, distilled from both brainstorming and satellite events, were showcased during a panel session at the main conference. All panelists had either attended the virtual brainstorm, the in-person satellite event, or both.

Preparing the guide for publishers: Discussion points were synthesized by the virtual brainstorming event organizers, forming the basis for a guide on collaborating with ECRs to improve the future of scholarly communication. An outline and two drafts were shared with brainstorming participants to gather feedback. The manuscript was modified at each stage, based on co-authors' input. Individuals who actively participated in the virtual brainstorming event and provided feedback on the outline and manuscript are listed as co-authors.

Priorities for change

Address technological limitations to create submission, publishing and indexing systems that meet the research community's needs

Researchers participating in the event shared several cases where technical limitations of submission, publishing, and indexing systems prevented publishers from meeting the research community's needs. Code review typically requires several exchanges between the code

reviewers and authors, as authors update their code and documentation to address problems. Some journals were unable to integrate code reviewers into editorial submission software; hence, code reviewers could not anonymously ask questions or share their reviews with authors. Sharing multilingual outputs is an important strategy for making research accessible to different language communities, and to citizens and national or local decision makers who may benefit from published research (e.g., Amano et al., 2023a, https://www.helsinki-initiative.org/). Participants, however, reported cases where journals were unable to adapt the article website to allow readers to quickly see abstracts and other key information in different languages, even though the authors provided translations (e.g., Amano et al., 2023b, 2023a; Kent et al., 2022). Translations were shared as supplemental material, which is inefficient for readers and inaccessible to search engines. Participants also highlighted the prohibitively high cost of integrating new features into online submission systems, such as automated tools to screen submitted papers for common problems or beneficial practices (Schulz et al., 2022). Additionally, many articles are only offered as PDFs. This makes it difficult to search for or access machine actionable information, especially in tables and figures. Solutions include facilitating the use of different formats (e.g., vector-based graphics, html, XML) and enabling multi-format publication (e.g., Heidt, 2024). Open research information, semantic structuring, and machine actionable interoperability (e.g., via Open Research Knowledge Graph, OpenCitations, DataCite, Crossref) could aid discoverability and provide context, given that the information is accessible in open infrastructures under permissive licenses.

The research community needs modern submission, publishing, and indexing systems that can be easily and inexpensively adapted to the research community's needs. A sustainable development could be built on free and open source software (FOSS) with funding from multiple sources and institutional commitments (e.g., Open Journal Systems, ResearchEquals). Hackathons and other co-creation formats may allow scientists and publishers to create small tools to address specific problems and meet both researchers' and journals' needs. One example of this is the eLife Innovation Sprints (https://sprint.elifesciences.org/index.html%3Fp=5674560.html). During these 2-day hackathons, ECRs and other scientists work with designers, software developers, and other innovators to develop new or extend tools to enhance publishing.

Publishers can also explore other strategies to address technical limitations. Several publishers and organizations, for example, seek to remove barriers to sharing and accessing multilingual or non-English language articles. The online journal GigaScience allows authors to publish the same article in English and in their native language (Edmunds, 2022). Journal staff realized that authors who were not native English speakers were often writing manuscripts in their native language, before translating them to English. Only the English version was submitted to the journal. Staff adapted their procedures to allow authors to publish articles in both languages, making the research accessible to a broader audience. AfricaRxiv also encourages authors to submit work written in their indigenous languages (https://info.africarxiv.org/fostering-multilingualism-in-african-scholarship-through-digital-tools/). Journals that can't display different languages on their own publishing platforms could include translations provided by authors in

the XML-based source of a rendered article (Edmunds, 2022). PubMed Central has sufficient tooling to be able to display different languages.

Fostering diversity, equity, inclusion, and accessibility

This section briefly summarizes some of the actions that publishers could take to foster diversity, equity, inclusion, and accessibility (DEIA), which were discussed during the event. These include actions at the journal and publisher level, at the publication or research output level, and at the authorship level. Publishers should consult with ECRs and others to identify priorities for their communities, explore solutions, and adapt and refine existing programs.

At the journal or publisher level: Cultivating DEIA during the editorial and peer review processes requires diverse and representative editorial boards. Factors that should be considered include gender, race and ethnicity, geographic location, physical ability, sexual orientation, and career stage (COPE article, Report from Elsevier's Inclusion & Diversity Advisory Board, eLife report). Monitoring progress requires collection of personal information. This should be done transparently, in accordance with national and international laws. Requests for data should include a clear explanation of why the data is needed and how it will be used. Publishers can issue open calls to increase representation, instead of relying on editor's existing networks (e.g., eLife's open calls for editors based in Latin America and Africa). Efforts are also needed to increase diversity among peer reviewers and authors. Editorial boards and reviewers may benefit from training on topics such as accessibility, inclusion, and diversity to mitigate bias during peer review (https://publicationethics.org/resources/forum-discussions/bias-peer-review).

Paywalls severely limit access to published research, while article processing charges (APCs) constrain authors' choices about where to publish. The consequences of these inequalities are especially strong for researchers in countries with comparatively limited research funding. These financial barriers also limit access for citizens, policy makers, and others who may benefit from research, as well as researchers from smaller institutions with limited resources for subscriptions and APCs. Publishing costs, and hence APCs, increase with selectivity. Some researchers perceive the ability to publish in a highly selective journal as a marker of quality, overshadowing the fact that this is also a marker of access to resources, including money, equipment, and networks. While publishers offer fee waivers and reduced subscription costs for authors in countries with limited research funding, paywalls and APCs remain a major obstacle for many researchers.

At the publication or research output level: One strategy to foster DEIA at the level of the research output is for publishers to encourage and make it easier for authors to post preprints or to archive postprints in openly accessible repositories. Preprints of the submitted manuscript or author-accepted manuscripts as postprints offer accessible versions to readers who lack expensive institutional subscriptions to paywalled journals.

A second strategy is to embrace multilingualism. This is crucial for both researchers (Amano et al., 2016) and those who use or benefit from research. In biodiversity assessment reports for different nations and territories, for example, 65% of cited resources were not published in English (Amano et al., 2023a). Some options for achieving this goal were discussed in the preceding section on technological limitations. This may include publishing papers, or titles and

abstracts, in additional languages. Expanding efforts to index non-English publications would enhance findability and accessibility for readers who are not native English speakers.

Publishers can also encourage authors to make papers more accessible. This may include requesting colorblind accessible color palettes, or encouraging authors to provide figure and table captions that are informative for readers who use text reading software. Using existing tools to screen submitted papers for potential accessibility issues (e.g., Accessibility Checker, JetFighter) could further mitigate this problem. Further, scholarly work may be shared more broadly and accessible via video or audio recordings, such as PubCasts which are abridged and annotated audiobook-style recordings (Harrison and Loring, 2023).

In addition, to reduce research waste, foster reproducible and open science practices, and equity barriers, DEIA principles should be further included in open access initiatives and publishing models (Landis et al., 2023).

At the authorship level: Publishers can use several strategies to foster DEIA among authors. This includes introducing policies to stop parachute science (Odeny and Bosurgi, 2022), and using CRediT (https://credit.niso.org/) and/or MeRIT (Nakagawa et al., 2023) author contributions statements to recognize a full range of contributions, including roles that may be overlooked when determining authorship. Publishers can also adopt inclusive name change policies that allow each co-author to provide a statement without involving the corresponding author (e.g., Wiley's name change police, COPE guest article, https://www.rsc.org/policy-evidence-campaigns/inclusion-diversity/joint-commitment-for-action-inclusion-and-diversity-in-publishing/).

Finally, there is a need to support authors and researchers from underrepresented countries and backgrounds more widely. Several barriers to publish research specifically affect researchers based in lower- and middle-income countries. These barriers include high publication charges, language barriers (Amano et al., 2023b), limited funding to perform original research or suggested reviewer experiments, and limited access to resources. These barriers can be addressed in different ways, such as lowering profit margins, expanding waivers or discounts to authors from low- and middle-income countries or ECR authors, and exploring more equitable publishing models.

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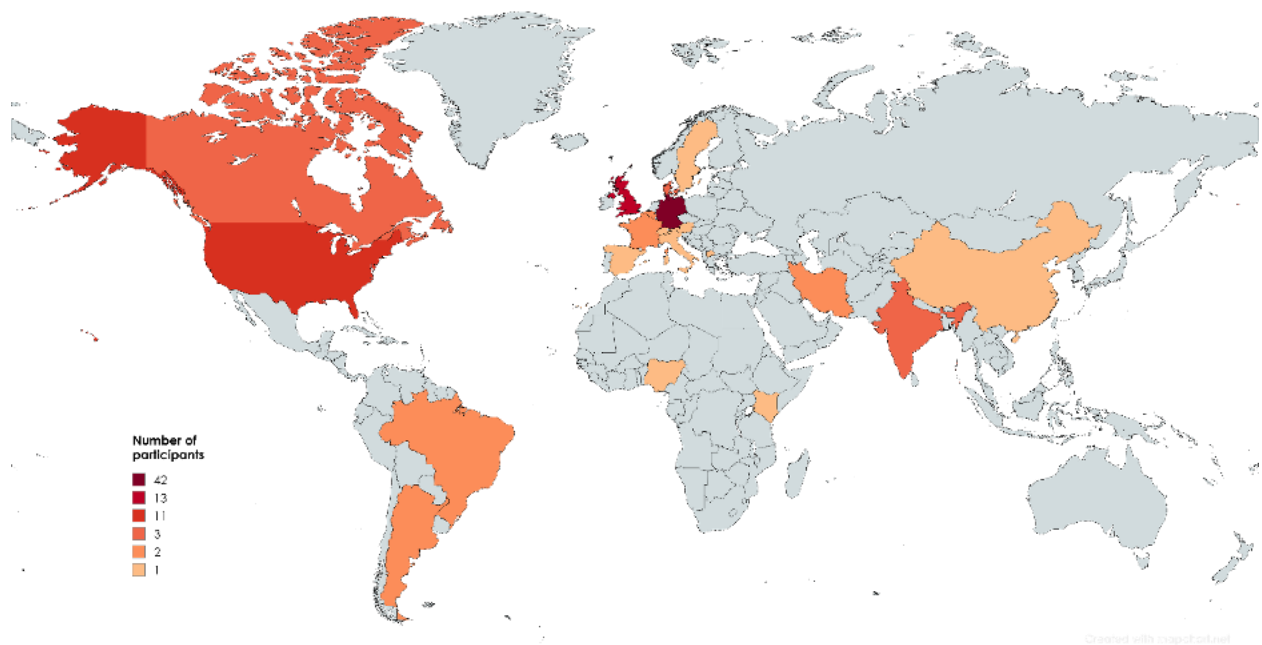
Figure S1: Unconference participation
Ninety-four participants from 20 countries across 5 continents and 10 time zones joined the virtual unconference. Countries represent the location of the participants' home institutions or organizations at the time of the event.

The figure was created using MapChart.net under a Creative Commons Attribution-ShareAlike 4.0 License (https://www.mapchart.net/index.html).