The impact of generative AI on the scholarly communications of early career researchers: An international, multi-disciplinary study

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Abstract: The Harbingers study of early career researchers (ECRs), their work life and scholarly communications, began by studying generational—Millennial—change (c.2016), then moved to pandemic change (c.2020) and is now investigating another potential agent of change: artificial intelligence (2024–). We report here on a substantial scoping pilot study that looks at the impact of AI on the scholarly communications of international ECRs and, extends this to the arts and humanities. It aims to fill the knowledge gap concerning ECRs whose millennial mindset may render them especially open to change and, as the research workhorses they are, very much in the frontline. The data was collected via in-depth interviews in China, Malaysia, Poland, Portugal, Spain and (selectively) the United Kingdom/United States. The data show ECRs to be thinking, probing and, in some cases, experimenting with AI. There was a general acceptance that AI will be responsible for the growth of low-quality scientific papers, which could lead to a decline in the quality of research. Scholarly integrity and ethics were a big concern with issues of authenticity, plagiarism, copyright and poor citation practices raised. The most widespread belief was AI would prove to be a transformative force and would exacerbate existing scholarly disparities and inequalities.

THE NATURE AND PURPOSE OF THE STUDY

Artificial Intelligence (AI)—in particular Large Language Models (LLM) and Generative AI—has attracted enormous attention over the past 2 years. It could be another false dawn—suppositions of human-level intelligence are overblown—yet this appears an advance in automation; one as significant for scholarly production as word-processing and desktop publishing, the internet, and the web. It may not stand-up to its hype, but it is causing a stir and will leave a mark. There is plainly a gold-rush in progress. Despite

all the above, while there are a flood of prognostications there is still little empiric, robust evidence available regarding the practice, process, advantages, disadvantages, or risks of using generative AI tools in scholarly communications. Thus, an extensive literature review conducted by the project found just half-a-dozen papers covering how it affects the scholarly world (for instance: Hosseini et al., 2023; Nordling, 2023a,b; Van Noorden & Perkel, 2023). This is a situation that needs to be redressed: if these tools do prove to be influential, changing the way we conduct research, the effects on the efficacy and integrity

of the body of human knowledge may have far-fetching implications for all.

The pilot investigation, which forms part of the third stage of the Harbingers study, aims to fill the knowledge gap via a study of international early career researchers (ECRs)—tomorrow's professors and scholarly influencers, whose millennial mindset may render them especially open to change.

PROJECT DESCRIPTION

Harbingers-3 looks at the impact of generative AI on junior researchers, how it affects the way ECRs do research, and how they integrate generative AI tools into information and publishing practice. We compare awareness of these tools with evidence of familiarity and use, their perceived expediency and limitations. Thus, to determine the implications of generative AI tools for the achievement of integrity, transparency, and openness in the creation of information and its publication. The study is firmly anchored in the context afforded by the longitudinal Harbingers projects 'change' data, which had the transformations occasioned by social media, open science, millennial attitudes and the pandemic at its heart. A short account of the Harbingers studies and a full list of publications arising out of all three rounds of the study can be found at https://ciber-research. com/download/ECRs_Harbingers_3_publications-20230912.pdf.

AIMS

Given the exploratory nature of the study (a pilot) and the novel nature of the subject (AI) we sought to unearth the big issues. To see through the fog of comment and prognostication and see what ECRs are thinking and doing in respect of AI. However, there were issues to which we were already alert, questions, highlighted by the literature:

1. How widespread is the use of generative AI tools: how and for what scholarly purposes with what advantages and disadvantages?
2. How can ECRs take meaningful steps towards fostering trust around the use of generative AI tools?
3. Do ECRs want generative AI tools integrated into their research? What are the potential gains and losses?
4. Where ECRs place the limits to the use of these tools, that is, what their red lines are?
5. What risks generative AI poses for scholarly integrity and how ECRs hope to deal with it?

SCOPE

Early career researchers

Lacking a universally accepted definition, a pragmatic concept of the ECR has been adopted. It focuses on common factors: their

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Key points

- The study showed how widely ECRs ranged in what they perceived to be AI and how important LLMs are already to the authoring process.
- There was widespread acceptance that AI will be responsible for growth in low-quality research.
- Scholarly integrity and ethics were a big concern with issues of authenticity, plagiarism, copyright and an absence of citations raised.
- The most widespread agreement among ECRs was that AI would: (a) exacerbate existing disparities and inequalities; (b) prove to be a transformative force.

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being employed in a research position, being relatively young, in an early phase of their career, not yet established as permanent faculty. Thus: Researchers who are generally not much older than 40,[1] who either have received their doctorate and are currently in a research position or have been in research positions, and are currently doing a doctorate. In neither case are they in established or tenured positions. In the case of academics, some are non-tenure line faculty research employees.

Subject

Throughout, the Harbingers project has covered science and social sciences, but with this iteration we have been able to include the arts and humanities. Comprising over a third of the cohort (33) we may now venture some exploratory comparisons with other disciplines.

Country

While it is a collaborative international study, including China, Malaysia, Poland, Portugal, Spain, United Kingdom and United States the differences in the size of the national cohorts mean country comparisons can only suggest things for a bigger study to investigate, which is our intention.

Artificial intelligence

AI has no firm or formal definition; how could it when intelligence of even the 'natural' variety escapes a hard and fast definition? Consequently, when asking about attitudes to and anticipations of the place of AI it necessary to ask: 'what do you mean by AI'. A set of general questions at the start of the interview were posed to provide that context. The responses confirm the variety of tools and applications to be considered as

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[1]While this was true for H-1 and H-2 more ECRs in their forties are in H-3 because our cohort has aged.

'AI'.'Essentially, we were seeking to establish a definition and scope by way of user warrant.

LITERATURE REVIEW

Generative AI systems and tools, and particularly the open-access, LLMs-based chatbot ChatGPT, are so often said to have taken the world by storm, that the expression has already become a worn-out cliché. A cliché it may be, but it is a true reflection of reality: in just 5 days after its release at the end of 2022, ChatGPT surpassed 1 million users, a number which, 18 months later, has grown to around 180.5 million (Duarte, 2024). Arguably with good reason, too: AI-powered tools, with their basic functionality of 'ask me anything and I may have a good answer', do indeed hold a great promise, given their potentially positive effects on the research and problem solving that form such an important part of living in today's information- and knowledge-based world (Dwivedi et al., 2023). However, as it stands, the hype surrounding AI does not translate into much of a behavioural change in information-associated activities.

Take, for example, the situation in the United States, as exemplified by familiarity with, as opposed to actual use of ChatGPT: according to Pew Research Center surveys conducted in 2023, while most Americans are aware of the chatbot, firsthand experience with it is relatively uncommon. Thus, 58% of adults have heard of ChatGPT, but only 24% among those who have heard of it said that they had ever used it, which amounts to 18% of US adults overall. In fact, Americans are increasingly cautious about the growing role of AI in their lives, with 52% of Americans feeling more concerned than excited about its advent, 36% reporting a mix of excitement and concern and just 10% saying they are more excited than concerned (Pew Research Center, 2023a). Still, according to the Pew data it is people with higher education degrees who are more likely to use AI, and it is information workers who are among the most likely to believe that chatbots will have an impact on their job (Pew Research Center, 2023b), and scientists may very well join the ranks of the early adopters of AI tools and systems in their professional pursuits.

The possibility of harnessing AI for scientific work has been much discussed in the scholarly world ever since the advent of ChatGPT, with countless prognostic analyses, opinion pieces and editorials debating the pros and cons of the ways in which widespread adoption of AI might impact scientific knowledge production and communication (Alvarez et al., 2024; Dwivedi et al., 2023; Fui-Hoon Nah, Zheng, Cai, Siau, & Chen, 2023; Messeri & Crockett, 2024; Susarla, Gopal, Thatcher, & Sarker, 2023; Van Dis, Bollen, Zuidema, Van Rooij, & Bockting, 2023). In fact, AI has even been hailed as a transforming agent, if not an actual game changer when it comes to scholarly undertakings (see, e.g., Cho & Jung, 2023; Ermak, 2024; Van Dis et al., 2023; Zhou, 2023).

These analyses, indeed, the first empirical explorations of the developments underway (ERC, 2023; Hosseini et al., 2023; Nordling, 2023a,b; Owens, 2023; Van Noorden & Perkel, 2023; , Watermeyer et al., 2023), lead to the conclusion that AI-based tools have considerable potential for benefiting research. The most talked-about potential seems to be AI's capability to help with repetitive, labour intensive, or boring tasks, such as crunching numbers or analyzing large data sets, writing and debugging code, and conducting literature searches. Beyond that, AI is said to have the potential to be of help in performing less 'mindless' tasks, too, such as brainstorming emerging ideas, producing a research manuscript—a real bonus for non-native speakers of English, expediating the dissemination and publication of research findings, inclusive of choosing the 'right' outlet for publication, and even assisting in improving the efficacy of peer review. Nevertheless, there is also wide agreement that these benefits may come at a price, as the quality of the information produced by generative AI models, which largely depends on the quality of the data that these tools are trained on, is not always up to par. Thus, AI could also degrade the quality and transparency of research, bringing about the production of poor-quality papers with inaccuracies and plagiarism, and lead to entrenching bias or discrimination in data.

However, in academia, too, a closer look at what we already know about the happenings on the ground indicates that the extent of scholars' utilization of AI in their research activities is yet to bear testimony to the revolutionary changes that educated prognostications would lead us to expect (Herman et al., 2024). True, there is only a limited body of empirical evidence on which to base our appreciations of the situation, but the data we have suggest that researchers are only feeling their way rather than wholeheartedly embracing AI.

Indeed, the few empirical studies there are come together to form a picture of scholars' cautiously dipping their toes in the water, as an early *Nature* survey—one of the first empirical studies to investigate the utilization of AI for scientific activities—already exemplifies (Owens, 2023). In the survey, the 672 readers who responded to an online questionnaire already seemed keen to experiment with ChatGPT or with a similar AI tool: around 80% of the respondents had tried their hand at it at least once. However, interest does not seem to translate into actual use: only 8.4% of the respondents used the chatbot every day; indeed, only 13.9% reported having used it more than once. The rest of the respondents either only occasionally used it (17.9%) or their use had been limited to 'let's try it out' (39.3%), or they had never used it at all (20.6%). Moreover, 57% of the participants who did have some experience with chatbots said they used the tools for 'creative fun, not related to research'.

The results from another *Nature* survey (Van Noorden & Perkel, 2023), conducted half a year or so later, this time among more than 1,600 researchers around the world, paint a similar picture. Here again scientists were found to be excited by the potentials of AI, with many of them reporting to have at least tried the tools, and tending to predict a bright future for AI-supported research work. Indeed, more than half of the respondents said that they expected AI-powered tools to become very important or essential within a decade. At the same time, though,

they seemed to shy away from using AI to any great extent in their research work, with 'creative fun unrelated to research' again proving to be the most popular use. Certainly, regular users of AI products at work were still in a minority: even among those who directly developed or studied AI only 28% used AI tools every day or at least more than once a week, a percentage that dwindled to 13% among researchers from non-AI related disciplines, but who had already utilized AI for research purposes. It is perhaps telling that even among developers or students of AI only 4% thought that AI-afforded tools had already become essential.

The evidence from a survey of 284 UK academics, which looks at academics' utilization of AI within the wider framework of the ways they opt to alleviate their employment precarity, lends further support to the 'attitude versus actual use' patterns identified above. Here again, empirical evidence indicates that hopeful interest in AI tools was more prevalent among the participants than actual use. Thus, while there was a roughly even split between those using and those not using AI-powered tools—51.5% and 47.7%, respectively—72.3% of the respondents stated that AI was already changing how they work and a further 83.2% anticipated using AI more in the future (Watermeyer et al., 2023).

Similarly, a survey of 1,034 European Research Council grantees, conducted in parallel to the previous study, re-affirms that hopes run high when it comes to the potential role that AI can play in research undertakings. Thus, high percentages of the respondents exhibited optimism towards AI-afforded key opportunities: 88% of respondents thought that AI would accelerate the scientific process, 81% found it 'highly likely' or 'likely' that AI-human collaboration would become widespread, 75% believed that AI would facilitate knowledge sharing and interdisciplinary work within and across scientific fields, 74% said that AI would bring about greater accuracy of the scientific process. However, although the report states that AI is widely used across various research fields and purposes, and that this widespread usage has been, at least partially, spurred by recent advances in generative AI, no data are provided as to the extent of use.

Finally, and obviously most importantly in the context of the research reported here, which focuses on junior researchers, an exploratory study into the use of ChatGPT in education, research, and healthcare finds that junior academics are not only more interested in using the technology than senior faculty, having more positive views, interest, and acceptability beliefs in using it, but more of them had already tried it, too (Hosseini et al., 2023). However, the results of a *Nature* survey of postdocs indicate that ECRs, too, see AI, at least for the time being, as a mixed blessing. Excited by the potential of AI, certainly, but equally aware of the need to exercise caution in considering them, only 31% of the employed respondents used chatbots for work purposes. Among the users, only 17% used chatbots daily, 43% used them weekly, 23% monthly and 17% less than once a month. All in all, around two-thirds of the postdocs participating in the survey did not feel that AI had changed their day-to-day work and career plans (Nordling, 2023a,b).

METHODOLOGY

Recruitment of interviewees

National interviewers recruited ECRs (from China, Malaysia, Poland, Portugal, Spain, United Kingdom and United States) using their local research networks and connections supplemented by mail-outs from scholarly publisher lists. For the study, each country was originally allocated a quota of 10 interviewees as was fulfilled by Malaysia, Portugal and Spain. In China, AI turned out to be a very hot topic and 21 were recruited. In Poland, 32 were recruited as local funding provided the opportunity to include the arts and humanities (National Science Centre in Poland, grant number: 2022/45/B/HS2/00041). The United Kingdom/United States were represented by just 7 ECRs due to time constraints. France, although originally part of the project, found it impossible to recruit any ECRs, because of their fear of providing their opinions 'on the record'. Given the pilot nature of the project, the imbalance in country coverage was not considered to be an issue given the importance of China internationally and the attraction of extending the study to the arts and humanities. A total of 91 ECRs were recruited.

Interviewees included ECRs who participated in Harbingers-2 and were happy to continue (26) and new ones (65), recruited to fill the ranks of participants who had left research, no longer qualified as ECRs or declined because of work commitments or lack of interest.

The breakdown of the ECR cohort by country, discipline, gender and age band are given in Table 1. Note especially the age of the cohort and how many relatively old researchers there are. Mainly, for convenience in what was essentially a pilot, we retained ECRs from previous stages of the project and hence they are all a year or two older. It is the nature of academic, or indeed any employment, that not everyone moves forever upward and onward. Contrarily, a few researchers who were ECRs at the time of H-2 have since become tenured yet have been retained in the cohort.

The broad disciplinary breakdown is: Science 54 (59%); Arts and humanities 23 (25%); social sciences 14 (16%). So, we are strong on science, sound on A&H and weaker on social sciences. We attribute the imbalance to: (1) H1 and H2 were science heavy because of the interests of the original funders; (2) the availability of recent funding to include arts and humanities ECRs in Poland.

Data collection

Semi-structured, free flowing interviews of 60–90 min in duration were the main source of data and this was supplemented by the professional knowledge of the national interviewers. The interview schedule consisted of seven pages of questions, covering broad AI matters, general scholarly communication questions and questions about the impact of AI on scholarly activities. This paper concerns the AI-related questions and there were 16 of these. All these questions were open in that they invited ECRs for their free-text comments and some of these questions,[2]

TABLE 1 Demographic breakdown of cohort.

	Discipline									
	CHEM	ENV	AHUM	LIFE	MATH	MED	PHY	SOCH[a]	SOCS[b]	Total
N	7	4	23	6	9	12	16	5	9	91
%	8%	4%	25%	7%	10%	13%	18%	5%	10%	100%

	Country								
	CN	ES	GB	MY	PL	PT	US		
N	22	10	3	10	32	10	4		91
%	24%	11%	3%	11%	35%	11%	4%		100%

	Age						
	Youngest (25–29)	Younger than most (29–34)	Median (34–37)	Older than most (37–39)	Oldest (39–51)	N/A	
N	18	18	18	18	18	1	90
%	20%	20%	20%	20%	20%		100%

	Gender		
	Male	Female	
N	48	43	91
%	53%	47%	100%

[a] Includes Economics and Business, Geography and Psychology.
[b] Includes Anthropology, Politics and Sociology.

additionally, had a quantitative (Yes, no, don't-know and not-applicable) element to them.

Data analysis

All interview transcripts accepted by ECRs were translated to English where necessary and transferred by the national interviewers to a coding sheet, which closely matched the questions of the original interview schedule, but left room for information derived from additional enquiries or clarifications during the interview process. The coding sheets were multi-faceted, containing quantitative and qualitative data, and a question could generate both. For most questions, the coding sheet captured a quotation from the ECR and sometimes an explanatory comment from the interviewer. All data were put into a database and interrogated to provide analyses, demographic patterns, keywords and to spot thematic patterns.

RESULTS

AI in general

Prior to the questions about scholarly communication, we asked several general AI questions. Using a technique developed when investigating social media usage (Clark et al., 2024) we examined what ECRs mention when asked about AI in the round. Thus, not presuming any conception of 'what is AI', but noting what

themes emerge from the conversation, what 'apps', programs, uses and abuses, come to mind when talking generally about AI.

ChatGPT is over-represented here (Table 2); given that it initiated something of a 'Cambrian Explosion' of interest and investment in LLMs and generative AI, it would be impossible to eliminate the element of prompting for comments about that application. That aside, the collation below is taken only from the 'Section B' questions; that is, those specifically about AI, not scholarly activity in general, and we have omitted many more that that are obscure. There is a mix of generic and specific terms and it should be noted that 'Google' will include both the generic search engine and other products such as Bard. AI, as seen by our

TABLE 2 Platforms mentioned in the context 'AI'.

'App'	ECRs
ChatGPT	68
Generative AI (general reference to)	15
Google	11
Grammarly	8
Translator/translate	6
Large language model (LLM)	6
Bing	5
Baidu	5
DeepL	5
Midjourney	5
Nest	3

interviewees, merges into the world of familiar and widely accepted applications.

Perhaps, the key thing to note is how LLMs are already integrated into the authoring process. Grammarly, for example, does not immediately present itself as 'AI' and yet it is mentioned in this context quite frequently. AI in practice, here and now, is used just as spell-checking and auto-complete are used, as an automation of the more tedious parts of the writing process. It also features as a way around language barriers and even 'writers block'.

Indeed, we can see here a demonstration of the principle that there are, arguably, two motives for automation: because things are too hard, or because they are too easy. Spell checking and so forth is not hard but boring, tedious. Adopting the right tone, even in one's native language, can be a hard task, so why not let the machine provide guidance?

AI and scholarly communications

Now to the analysis of key questions on the impact of AI on a wide range of scholarly activities. We will examine them in chronological order of asking and summarize their findings and provide illustrative quotes. This 'aerial' approach enables us to provide a broad analysis of many scholarly activities, which will provide a platform for further analysis going into the fine details of the comments and quotes. As we have said previously, some questions were coded up quantitatively (yes, no, etc.) and for these questions we have examined more closely the diversity of the response; for others we have taken a thematic analysis approach. In the case of three questions, more than half of ECRs noted or expected an AI impact. These questions were on reputation, transformational change and inequalities. Activities where there was little anticipated AI impact included authorship policies, detecting gaps in knowledge, and where to publish papers.

AI and reputation

Q. Does AI have implications for research reputation? If so, what are they?

This was a challenging question and was one which could deliver both a code and comments. The advantage of this dual approach is that it allows for the verification and explanation of the coding process. A quantitative and thematic analysis showed that the responses can be categorized as:

1. Yes, there was an impact, with no further explanation provided as to whether this was a positive or negative. Nine out of 91 (10%) of responses fell into this category;
2. Yes, there was a positive impact (9/91; 10%);
3. Yes, there was a negative impact and (20/91; 22%);
4. Yes, there was both a positive and negative impact (18/91; 20%);
5. No, there was no impact (21/91; 23%);

6. Don't know enough to provide an informed answer or did not see the relevance of the question (14/91; 15%).

So, over two-thirds (63/91) thought AI would have an impact with most believing it would be a negative one, although it was closely followed by those who believed it would have a mixed impact. Relatively speaking and allowing for the different sizes in the country cohorts, the Spanish were more likely to take a positive stance; the Portuguese a negative stance; and the Poles were equivocal.

Thus, we received this relatively positive response, if hedged, highlighting the increase in quality benefits from a Spanish chemist:

> *Yes, because it helps increase the quality of publications through deeper analysis. It can also increase productivity and decrease transparency.* [Spanish chemist]

Productivity, also mentioned above was in fact mentioned many times as a benefit. By contrast, this negative response was obtained from a very honest Portuguese chemist:

> *Yes, considering that the generalised capacity for scientific production by less experienced and lower quality researchers will increase, the overall quality of research will decrease. In the medium to long term, it could damage the reputation of research.* [Portuguese chemist]

Then there is this balanced response from a Polish A&H ECR:

> *I think artificial intelligence brings pros as well as cons. Of course, it can increase the productivity of science, e.g. in medicine; if there is still such a scoring chase in Poland, then maybe scientists will write more in other fields, although the question remains whether they will write better. I think AI can also lead to reputational damage. We need to be aware of the limitations of this technology.* [Polish A&H ECR]

Chinese ECRs dominated the group that felt there would be no impact, but provided little explanation why. Follow-up research showed that this was because Chinese ECRs do not consider expanding research influence (reputation) as being important. The pressure of academic evaluation and assessment is mainly towards publishing in top journals. Where to publish is more important than whether the research itself is innovative and influential. When asked this question, there was little to say, tacitly assuming that expanding influence was not very important. In this context the potential to use AI tools to translate and summarize for a wider audience is not considered. The Poles provided the most "don't knows", and this was largely because of the numbers

of A&H ECRs in their cohort who tended to think it was not an issue for their community.

AI and information discovery

Q. Has searching and discovery behaviour been impacted/changed in any way by 'AI'?

A majority (56, around two-thirds) of ECRs felt their behaviour had not changed. Chinese ECRs felt this most strongly with 18/22 saying so, followed by Spain (7/10), with Malaysians at the other end of the scale saying their behaviour had changed (7/10). Physical scientists were more likely to say it had not changed (13/15) and Mathematical scientists most likely to say it had (6/8). The median age and oldest age groups were more likely to say behaviour had changed (8/17). Gender differences were minor.

Only nine Chinese ECRs left a comment, which probably indicates it was not a question of real concern or deliberation, but here are examples of not impacted responses that came with an explanation, which was that they could not trust AI with these activities:

I have searched for academic papers using New Bing, but the search results provided by the search engine are not accurate. [Chinese soft social scientist]

Sometimes it will provide wrong information, and it will take a lot of effort to correct the mistakes, so it's better not to use it. [Chinese physicist]

The Malaysians that were impacted clearly felt AI was beneficial:

I've started talking to my phone for searches. You know, AI in voice assistants has totally changed how we find stuff, even if it's not that much of use for scholarly searches. [Malaysian soft social scientist]

Scite, smart citation analysis, assists in searching for literature and provides context, highlighting relevant quotations and their connection to the search term. Ask ChatGPT too at times. [Malaysian mathematical scientist]

AI and sharing/networking

Q. Does AI have implications for connecting and/or research sharing?

This question, perhaps because it was not always fully understood or few people had thought hard along these lines, tended to obtain more of a simple yes and no response, with many exhibiting a degree of uncertainty in their answers. Often, the answer included a suggestion as to how AI might impact (or not) on connecting/sharing. Clearly, quite a few ECRs did not have sufficient personal experience to comment further.

ECRs were split down the middle with 34/91 (37%) saying there were implications and the same number saying there were not. Nearly a quarter just did not know and a lot of these were A&H ECRs from Poland, who tended to be generally less familiar with AI. Malaysians were more likely to say yes, for instance:

Use ChatGPT to come up with compelling networking messages. It helps with thoughtful and engaging notes when I'm reaching out to researchers or potential PhD students, making my connection game strong! [Malaysian mathematical scientist]

AI makes chatting and sharing information cool, adding smart replies, suggestive texts and translations, making our communication smoother. Even in WhatsApp becomes even handier with these smart features, It's like your chat sidekick suggesting what to say next. Very practical for keeping the conversation flowing without much effort. [Malaysian life scientist]

This answer from a Chinese ECR shows an interesting international angle:

Yes, AI can help non-English-speaking scholars to optimise communication, for example, when we need to respond to foreign scholars, we can use AI tools to help modify the wording to make it more relevant. [Chinese soft social scientist]

The Portuguese and Chinese were more likely to say no and, in both cases, failed to add any form of explanation. Generally, those that said no provided little in the way of explanation, suggesting inexperience in this domain. Overall then, the data is thin, but what is clear is that the Malaysians were the pioneers and others might follow them.

AI and information quality/trust

Given the previous concerns we have heard from the published literature, this topic was covered by three questions. This is, perhaps, where we see the greatest ire and concern expressed and more universal agreement.

Q. What would make them suspect that published material was possibly AI generated?

As one Chinese ECR said: "*This is a difficult question to answer*" and this was largely because they never suspected anything like this might happen, have not encountered anything like this or never thought about it. Around a quarter shared their sentiment and nearly half of them were Chinese.

The biggest suspect, by some distance, is writing style, which was said variously to be mechanical, formulaic, stiff, and pompous by many.

For instance: *The writing style contains obvious formulaic/generic expressions, excessive hollow phrases. And the transitions*

between paragraphs are relatively stiff [Chinese soft social scientist].

And: *I've read some reviews that don't sound like they're coming from a human being, it's more like a mechanical way* [Chinese medical scientist].

Finally: *Well, spotting AI generated papers is like being a detective. If the language is too consistent or even not consistent, or the information is just a bit too perfect. Also, look out for weird formatting like having a statement [that] "this is a revised version" something like that* [Malaysian mathematical scientist].

Other clues, mentioned by a few ECRs are:

- ChatGPT follows a typical structure and once known that gives it away (this is because LLMs are trained to replicate human writing)
- The employment of sources that are too mainstream and with little originality
- Lack of, or inaccurate citations
- Obviously inaccurate data
- The lack of traces of the author's personality

Q. Do they believe that the AI-associated potential for rapid production of low-quality scientific articles brings about a decline in the quality of research output?

While a long question, it was really quite a simple and direct one. It lent itself to a yes or no answer, which was typically accompanied by an explanation and often a lengthy one, even from the Chinese.

The question struck a chord with ECRs and we had fewer "don't knows" than normal (13%). They also tended to go into detail with some relish. The general verdict is they are clearly worried about diminishing quality, with 68% (62/91) thinking so.

Malaysians were the most likely to believe that quality would fall with 9/10 saying so, with the Spanish close behind with 8/10. Nearly half of those believing it would not diminish quality were Chinese. Engineers also made the point that AI's impact on the quality of papers in their discipline was minimal, noting *a weak AI involvement in engineering fields*.

Let us look at a selection of the negative concerns, the first two mentioning worrying publishing practices:

True because AI can make papers quickly, it's a worry because it could be used by this shady publishers to churn out lots of content just for money, without caring much about quality. [Malaysian mathematical scientist]

AI contributes to declining research quality and fuels the growth of paper mills by automating article generation. AI can churn out loads of text that looks like scientific papers, but lacks substance or scientific rigor. Paper mills use this technology to produce a high volume of low-quality articles, publishing them without proper review or oversight. This undermines the credibility of scholarly publishing and spreads unreliable scientific information. [Malaysian physical scientist]

These ones centre on dubious practices to boost ones reputational score:

I think AI, unfortunately, can indeed be used to 'manufacture' articles to gain as many ministerial points as possible for periodic assessment. I suspect that reputable editors will certainly be wary of accepting articles of questionable quality, but AI could lead to a lot of abuse, which is by the way already noticeable. [Polish A&H ECR]

I predict that in the near future, predatory journals will be 'fed' primarily by articles written by AI. There is also a significant risk that the galloping development of AI and the temptation to rely on this ever-improving technological tool will contribute to an increase in unreliable publications. [Polish A&H ECR]

And, now to the "not so worried" category:

No, in my opinion, this low-quality research and questionable publications are very easy to detect. Although there are more and more of them, AI also works the other way round – in addition to creating low-quality articles, it also detects and eliminates them. [Polish medical scientist]

No. This won't happen. If everyone uses it, the threshold will be raised, and those who can't use it will be eliminated. With a significant number of users, there will be measures to avoid exploitation. It won't encourage the development of predatory journals, and the quantity will eventually reach a balance through natural selection. [Chinese mathematical scientist]

Clearly, this question raises an issue that needs watching and possible interventions by various authorities.

Q. Do they think AI is raising any other issues of scholarly integrity and ethics? If so, what are they and what can be done about it?

ECRs' answers were long and thoughtful. There were widespread worries and concerns on show, but not necessarily regarding the obvious suspects—deep-fakes and job losses. A good number—mainly Malaysians who seem to be very drilled—acknowledging that while there were other issues to address, these could be dealt with. This 'spill over question' (following two related questions) occasionally expanded further on what they had already said. Thus, highlighting topics on which they were very concerned. Fraud, plagiarism, ethics, low-quality material, authenticity and copyright were the major concerns raised. These quotes are representative:

Yes. It is difficult to guarantee the authenticity of the data when writing an article using artificial intelligence. In addition, it is difficult to determine whether the ideas and findings in

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Learned Publishing 2024

Learned Publishing published by John Wiley & Sons Ltd on behalf of ALPSP.

the study are actually presented by the author himself or herself. [Chinese medical scientist]

Yes. I believe that there are teaching and research personnel who are using AI to skip steps in research and publish results from AI as their own. He thinks that professors are behaving as students. [Spanish soft social scientist]

Yes. it is filling the journals with unoriginal articles that do not contribute much to the research. Sincerely, from my point of view they should be considered as plagiarism. [Spanish chemist]

AI raises the issue of not respecting copyright and not referring to source scientific texts. [Polish life scientist]

Recently, as I reviewed a paper from China, very obvious it uses AI, a significant issue caught my attention – as usual the cited sources were nowhere to be found. That's a serious red flag, isn't it. [Malaysian life scientist]

Those ECRs, while believing there were "other issues", were clearly wrestling with the problem and suggested some quite big changes to overcome the worst excesses of the situation unfolding. For instance, this from a Spanish chemist:

Modifying the evaluation criteria would be key to the integrity of the research. If the evaluation were not based on "weight" (the more you have, the more valuable you are), the high concern for publishing a lot would probably decrease, the more the better, sometimes abandoning interest in the quality of what is published. [Spanish chemist]

This, too, from a Polish mathematical scientist:

It seems to me that it is not the ethics of AI, but the ethics of people for what purposes they use it. This is a very difficult question that confronts the choice of developing technology versus protecting it from the irresponsibility of certain people. It seems to me that this dilemma is difficult to solve. [Polish mathematical scientist]

Of the genuinely new topics (in order of magnitude), legislation/regulation automation, job replacement, deep-fakes and problems of assessing student coursework were raised in relatively small numbers. This quote for illustration:

Violation of personal rights by deepfakes. In addition, too much automation of everyday life, aided by AI, can lead to convenience being prioritised over honesty and ethics, further exacerbating modern human isolation and social divisions. [Polish A&H ECR]

Summing up, we see that 60/91 (two-thirds) believed there were 'other' issues, albeit including previously mentioned ones; just nine (1-in-10) thought not and the remainder (19) were undecided or did not know. Malaysians were more likely to say yes and the Spanish undecided or knew too little to decide.

AI and authorship, writing and publishing

Q. Are authorship policies changing/being challenged because of 'AI' becoming (sort of) another (ghost) author?

The universal response was that policies had not changed or ECRs were not aware of changes, with 9 out of 10 believing this to be the case. Very few provided an explanation of why not, but this hard social scientist from Portugal did:

I have no idea. But AI can never be considered an author. The idea is ridiculous by definition, at least in the social sciences. [Portuguese hard social scientist]

As there were no significant differences in the cohort, the conclusion must be that there is little interest in this topic, which is perhaps surprising but it still might be early days.

Q. Has 'AI' helped publishing productivity?

AI has been shown elsewhere to speed up the writing process, yet approaching half (40; 44%) of all ECRs felt that AI has not helped increase publishing productivity. However, the numbers saying it had were still significant (33; 36%). So, there is a groundswell here for AI and it is one of the higher AI impacts observed. Poles are more likely to say there was no productivity gain (19/31) and the Chinese more likely to say there was (17/22). In fact, the latter accounted for over half of all those thinking there was a productivity gain, albeit some were not wholly convinced of this. A large proportion of physical scientists saw a productivity gain (10/14) and a similar proportion of medical scientists thought the opposite (8/10). The younger age groups were more likely to say it would help productivity and men were much more likely to say they saw a productivity gain (57% vs. 21% for women). A keyword search on all the other questions containing the term productivity showed that it had been additionally mentioned by 26 (nearly a third) ECRs. Clearly, then, productivity is a big issue. Some quotes from ECRs thinking increased productivity will be a dividend of AI follow:

We know that the function [ChatGPT] *is to some extent create an article, its useful for a person who has limited writing skill, especially for an ECR that has to come out with several number of articles within a short time. For sure, they will use.* [Using ChatGPT because of] *time constraints getting feedbacks that its* [draft] *is not up to level, article rejected because of writing style. The 'facility' is there already. But if I used it and it gets accepted* [for publication], *the tendency to use it again is higher. I will use it again, being dependant on it.* [Malaysian hard social scientist]

Artificial intelligence can be used for voice broadcasting, generating refined summaries, and creating content introductions, which can enhance the efficiency of publishing promotion and distribution. [Chinese soft social scientist who also, interestingly, contradicts the earlier observation that the Chinese do not employ AI for reputation]

It does help a bit. I now find myself with extra time that was previously spent on repetitive work. While AI has its perks, I haven't really experienced a substantial change in my publishing productivity, like having more published papers. However, I'm optimistic about its potential to streamline tasks in the future, which could open up more research opportunities. [Malaysian mathematical scientist]

This quote is from an ECR urging caution or believing it unnecessary:

Can help boost productivity, but if get misused to pull off shady research like tweaking data or results, it will seriously mess up the reputation of both the researchers and the institutions linked to that research. Not a good thing at all. [Malaysian mathematical scientist]

Q. Have used 'AI' as a tool for summarizing scientific articles/extract key information from complex texts to facilitate doing a literature review?

Just over three-quarters (70; 77%) of ECRs had not used AI to help conduct a literature review. Just 12 (13%) had. Nevertheless, there were notable differences, with Malaysians more likely to say they had (6/10) and Spanish ones saying they had not (9/10). Medical scientists were most likely to say they had not (11/11) and Mathematical scientists most likely to say they did (6/8). Older ECRs were most likely to say no, as were female ECRs. The following quote from an ECR provides a very rounded view:

I'm aware that such a feature exists, but I haven't used it because I have reservations about its accuracy. To be honest, I believe the technology has reached a certain level, but when it comes to understanding and correctly extracting the technical details I need, there's some doubt in my mind. Perhaps beginners might find it helpful for a quick understanding of articles, but at this point, I don't find it necessary. I can read and comprehend at a faster pace than it can generate, and my understanding is often deeper. Therefore, I prefer to read and comprehend on my own, paying close attention to technical details, as it provides more insights into our research process. [Chinese mathematical scientist]

Q. Used 'AI' to detect gaps in knowledge to locate a topic for new research and to construct hypotheses.

This is another one of the lesser used functions of AI with just 22 (24%) of ECRs availing themselves of it. Malaysia (4/10)

and Portugal (3/10) were the only countries where ECRs seem to use AI for these purposes. The mathematical sciences are the only subject area where there are signs of use (5/8). In terms of age, only the median age cohort showed some use (4/16); additionally, there is a much more use of the facility among men (23%) than women (5%).

Two quotes follow showing differences in opinion, first a negative opinion and then a positive one:

No. I identify the research gap and use AI to give me ideas on how to write out the research problem or research objectives, so mainly to enhance the writing style. [Malaysian mathematical scientist]

Super helpful tool for researchers. It can go through tons of data, find where we don't know much, the research gap comes up with new research topics, and create hypotheses for more study. [Malaysian chemist]

Q. Will 'AI' change their relative ratings of where to publish or introduce any new factors?

This question followed a non-AI question, which asked: When choosing a journal to submit their paper to, which factors rate most highly: (a) it is a high impact factor journal; (b) it has much prestige in the discipline; (c) appropriateness of the audience; (d) the speed from submission to publication; (e) it is open access; (f) the geographical location/origins of journal/publisher; (g) where it is indexed; (h) high standards of peer review.

Roughly two-thirds of ECRs (56; 62%) thought it would not change the rankings. However, the relatively high number of no responses (12) combined with don't knows (12; 13%) reduces the significance of the result somewhat. Mathematical science ECRs were most likely to say there will be changes (3/7). There were no other significant demographic differences.

Verbal responses tended to be minimal with little explanation provided, probably, showing that researchers did not see the point or purpose of it, but here is one that clearly did:

I might consider submitting to journals that openly disclose their use of AI, as they can provide guidance on the appropriate extent of AI use to streamline processes. [Malaysian physical scientist]

Q. What do you think an AI-based peer-review should be capable of doing, if it is to replace the current system?

This question strikes at the very heart of scholarly communications and from our results AI has a potentially big part to play here.

The majority view was that AI will have an impact and that would prove beneficial or positive (45; 49%), but few people—though there were some—thought it would totally replace the current system. Rather it was more a case of improving/

complementing the existing process. Regarding what aspects of peer review would improve courtesy of AI there were four that obtained good support: (1) deleting plagiarism/establishing novelty (12); (2) saving time/speeding-up the process (12); (3) matching/checking reviewers (7); (4) Assessing the quality/appropriateness of reviewers (4). Additionally, 3 ECRs said they thought AI would be a better reviewer altogether, avoiding bias, for instance. The Portuguese and the Malaysians were especially positive about the changes AI could make to the peer review system.

Just 12 (13%) of ECRs thought there would be an impact, but that it would be a negative one. Polish A&H ECRs dominated this category. A further 6 (7%) said there would be no impact, so only a very small percentage. The Chinese dominated this category. Fourteen (15%) did not know or were not sure. Typically, because they were not informed or experienced enough. Polish A&H ECRs dominated this category.

Examples saying there would be a positive impact

Yes. It is difficult to guarantee the authenticity of the data when writing an article using artificial intelligence. In addition, it is difficult to determine whether the ideas and findings in the study are actually presented by the author himself or herself. [Chinese medical scientist]

Firstly, reviewers can use artificial intelligence technology to assist with the review process, making it more accurate in terms of understanding research results and their innovation. Additionally, AI technology can be used to match reviewers with research results. I think these changes have the positive significance. [Chinese soft social scientist]

For AI to take over the current peer-review system, it needs to be fair, unbiased, and make sure the reviews are high quality, keeping scientific publications up to high standards. With AI, there might not be a need for high APC, showcase cost-effectiveness and potentially lessen the financial burden linked to the current peer-review system. [Malaysian mathematical scientist]

I think that in the future AI may influence the peer review process. I think it is possible for AI to even become a reviewer or at least give a formal opinion on an article. AI may also have ideas for improving the process. [Polish hard social scientist]

Example saying there would be no impact

Not in my field. I think it helps to write an article and solve programming errors, but it is still not capable of inventing a model that does not exist, programming it and making it work. [Spanish mathematical scientist]

Examples saying there would be a negative impact

AI better not replace humans in reviewing, it will only exacerbate existing problems, as AI has a bias because it learns from a base that is very homogeneous and not necessarily based on merit, and certainly not socially sensitive. The nuance will slip away. [Polish A&H ECR]

Research is a frontier of knowledge and as such it is current, not past knowledge which is on which AI algorithms are based. Also, it would not be desirable because all reviews would follow the same model and all articles would go in the same direction. It is dangerous. [Spanish hard social scientist]

AI and transformations

Q. Will 'AI' be a transformational force? If so, in what ways? What will be the advantages and disadvantages of the transformations that will take place?

This question obtained the highest level of overall agreement, with over two-thirds of ECRs (62; 68%) thinking that AI would turn out to be a transformative force. However, there was a little uncertainty about this with 28% either saying they did not know or not answering the question in the first place. Poles were the least likely to think it would be a transformative force with 23/31 saying so. This is partly because of the large numbers of A&H ECRs part of the Polish cohort as they were less likely to think it would be transformative. Soft social scientist were less confident, and there were no real age differences.

Some quotes from those believing AI was going to be a transformative force:

I think it will be. It will be a tremendously useful tool for research because it can process much of the information quickly, and report results that may be useful. For example, to know the state of the art on a specific topic. [Spanish chemist]

AI is totally going to shake things up in academia and scientific publishing! It's going to make research easier by helping with tasks like literature reviews and data analysis, which means more time to do quality research. Plus, it can even write manuscripts for us! But there are downsides too, like too much dependent, bias in AI, the data that they are trained on and worries about ethics and privacy. Still, if we use it right, AI could be a game-changer, speeding up discoveries and making research better for everyone. [Malaysian life scientist]

AI and inequalities

Q. Will the use of 'AI' exacerbate existing disparities and inequalities, with people with access to AI-based tools speeding up their publication processes?

The large majority (57; 63%) thought it would, with just 14 (17%) saying it would not. A huge balance in favour of the statement. All the Portuguese said Yes (10/10) and the Chinese

were more likely to say No (5/21). A&H ECRs were less likely to agree (11/23). No real age or gender differences were found. A flavour of the yes responses is provided by these two comments from Malaysians:

> AI might make the gap even wider. Those who've got AI tools can do their work faster. So, if you don't have access to that technology, you're left behind, struggling to keep up. That's why the government's all about pushing AI. They want to bridge that gap in society. If everyone's got access to these AI tools, then maybe we won't see such big differences in how fast people can get things done. [Hard social scientist]

> Yeah, that's a real possibility. Researchers and rich universities with fancy setups might get to learn and access AI tools more easily. This could create gaps in who gets to speed up their publication using AI. Some universities like in Singapore set their staff up with AI tools, but not all of them. Using AI well requires some specialized know-how, and not everyone has the same opportunity at quality training. So, it's like the haves and have-nots in the AI world. [Mathematical scientist]

Discipline analysis

We raised disciplinary differences in the previous analysis if we thought them to be interesting or significant, but with caution given the uneven representation of the cohort. However, some discipline aspects are worth further consideration because of their novelty. Thus, this is the first analysis Harbingers have conducted involving A&H ECRs.

For the AI impact questions, A&H ECRs were asked the same questions, which enabled us to make direct comparisons, whereas for the more general scholarly communications they were slightly adjusted to allow for their different ways of working, for instance to allow more for monograph publishing. The Polish national interviewer, who also interviewed science and social science ECRs, said they did not find the questions any more difficult than their counterparts and added the comment that it seemed to them that the differences about impact of AI did not differ according to the discipline, but on individual ECR characteristics, for example, attitude, curiosity, and openness.

There were however interesting differences in response to some questions and these were regarding AI:

- Helping publishing productivity, where they were generally less sure of the outcome (around a third thinking this), whereas virtually no science or social science ECRs were.
- Changing where to publish, where nearly half did not know and this compared to virtually no science or social science saying so.
- Being a transformational force, where around one in three either said no or they did not know, compared to one in seven scientists saying so.

- Exacerbating existing disparities and inequalities, where around a third had no opinion compared again to no scientists saying they did not know.

Another disciplinary finding, which requires further attention, is the possible difference between research in hard sciences—physical, mathematical, and engineering—and the nature of scholarship in arts & humanities. If we suppose one to be seeking well-defined and consistent results, the other more at home with ambiguity and interpretation, then are the potential challenges and opportunities the same? A matter for further analysis and digestion.

CONCLUSIONS

While AI prognostications abound, there have been few published papers providing empirical data on ECRs. None examine the topic in depth. As generative AI becomes mainstream, this research gives a timely view on what junior researchers are thinking and experiencing. International, interdisciplinary, and relatively sizeable in terms of the number of people interviewed, this is a pilot study, not wholly representative, seeking to identify key areas for a full-blown study. What we have found so far are but informed observations.

What emerges from 90-odd interviews (featuring scientists, social scientists and, for the first time, A&H ECRs) is interesting and compelling. ECRs are very interested in what they are convinced is a transformative topic. Combing through the rich interview data shows that younger researchers are not leaders in the new technology, as some observers may have thought, but quizzical: thinking, puzzling, wondering, reflecting and, in some cases, experimenting.

Especially important for the scholarly community, for the first time Harbingers has an A&H component. With this enhancement, we can consider whether A&H are different in any way. It seems they are; less familiar with AI and greater in their uncertainty of what might transpire, yet very considered in their views.

We need to bear in mind that when interviews were conducted with ECRs and especially in China, where interviewing took place in December 2023, many specialized academic AI tools were not yet available. So, the context of our discussions was ChatGPT. Months have passed, and many more AI tools, some specifically designed for research, have emerged. If interviews were conducted now, they might give different and more comprehensive answers.

The most interesting findings, perhaps, are:

- Questioning about AI in general showed how widely ECRs ranged in what they perceived to be an AI and how important LLMs are already to the authoring process.
- ECRs seemed unsure regarding the impact of AI on reputation. Although the majority thought AI would have an impact, they were divided as to what the impact would be. Those seeing a

positive impact cited increases in the quality and quantity of papers and those advocating the opposite cited an inflation in low-quality science because paper writing had become easier.

- ECRs seemed convinced that they could identify AI-authored papers—*separating out the wheat from the chaff* as one ECR put it—the biggest give away being the writing style, said variously to be mechanical, formulaic, stiff, and pompous.
- There was a widespread acceptance that AI will be responsible for the growth in low-quality research output.
- Scholarly integrity and ethics were a big concern with issues of authenticity, plagiarism, copyright and an absence of citations being raised. Modifying evaluation criteria to recognize the quality and not quantity of papers and more training were thought to be ways of reducing the risks.
- The most widespread agreement was that AI would: (a) exacerbate existing disparities and inequalities; (b) prove to be a transformative force more than any other. Few ECRs were brave enough to write it off.

AUTHOR CONTRIBUTIONS

David Nicholas provided oversight of the article and wrote much of it. Marzena Swigon undertook the A&H element. Clark provided the data analysis, technical support and insights. Herman did the literature review. The rest of the authors undertook their country analyses and provided general feedback.

ACKNOWLEDGEMENTS

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors. Polish data will be available in the open repository of the University of Warmia and Mazury in Olsztyn.

STATEMENT OF INFORMED CONSENT

Participants who freely opted to take part in the interviews were asked to provide their names and contact details for follow-up questions regarding the accuracy of the interview transcripts, but access to all personal data was restricted to the investigating team and was removed before the analysis of the results.

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