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Do Early Career Researchers Consider AI as an Opportunity or a Threat? A Pathfinding Study

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ABSTRACT

The article presents the latest (2025) iteration of the Harbingers longitudinal project on early career researchers (ECRs), artificial intelligence (AI) and scholarly communications. In conversation with a purposive and diverse sample of more than 60 ECRs in six countries and numerous subjects, we present an evaluation of a pressing issue: what impact will AI have on their work and career? An important issue is that widespread media speculation suggests that it is entry-level positions that will be hit hardest by AI. While ECRs were asked 50 plus questions during interviews, none were directly asked about changes to job security and employment prospects, yet much of relevance was volunteered in answering related AI questions. Adding a new methodological dimension to the Harbingers project, we employed AI (NotebookLM) for an initial qualitative analysis of the interview data, with findings reviewed and corrected by the national interviewers. We conclude that AI is a double-edged sword which has huge potential as well as posing significant challenges. The AI-assisted analysis proved effective at identifying broad themes, though human oversight was essential to capture nuance, differences between cohorts, and unusual cases. Finally, given that we were working with a select and relatively small sample to inform a larger study, the data should be seen as illuminating and filling a research lacuna, rather than a definitive result in a fast-changing field.

1 | Introduction

There are, by some estimates, over a million early career researchers (ECRs) worldwide¹ so anything seen to change or threaten their jobs is going to have a huge impact on the scientific endeavour. A serious challenge, of course, is coming from artificial intelligence (AI), which might make an already precarious job position even more so as AI is widely reported to hit entry-level positions the hardest (Almeida 2025; Brynjolfsson et al. 2025; Ravio 2025). And clearly, ECRs can be categorised as entry-level, especially as PhD students and postdocs are included among their number. While to date, there appear to be no studies published on the impact of AI on ECRs themselves, studies on broader sections of the working population estimate

that up to 60% of current jobs will require significant adaptation due to AI, with automation and intelligent systems becoming an integral part of the workplace (Kelly 2025).

This paper provides a timely assessment of what ECRs told us in ‘conversational’ interviews about their work life, employment status, and career prospects conducted as part of a Harbingers AI study (see Clark et al. 2025; Nicholas et al. 2025 for more information on background and methodology). It should be said at the outset that there was no question on the interview schedule that asked directly about this, and the information came, instead, from dozens of questions on work life and scholarly communication, such as: *What may be the benefits or problems involved in using AI for research?* This, though, we believe is an

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Key Points

Presents interview data from the fourth and most recent iteration of the Harbingers study (<https://ciber-research.com/harbingers-4/index.html>), which investigates the impact of AI on ECRs, their work-life and scholarly communications, with a particular focus on job opportunities, changes and threats. Uses, for the first time, AI (Google NotebookLM) as a qualitative analysis tool for the interview data, with the AI-generated findings reviewed and corrected by the national interviewers who possessed first-hand knowledge of the data. It was found that AI will change research work, but not necessarily to the detriment of ECRs; however, there lies in the background a concern, informed by our own experience, that the challenge is being underestimated or set aside.

advantage because without direct prompting (and putting words into interviewees' mouths), what was volunteered on occupational issues suggests a more conscious concern. Push people already in a precarious position about employment changes, and you either open floodgates or obtain broad platitudes.

2 | Aims

Prompted by a flood of reports on the threat or challenges to entry-level employment by AI, which suggest that these jobs are drying up (Almeida 2025; Brynjolfsson et al. 2025; Kelly 2025; Ravio 2025), we decided to conduct an exploratory examination of the most recent Harbingers data to see what the concerns were with respect to research-entry jobs.

Our primary aim was to obtain an initial understanding of the effect AI was having upon ECRs, their scholarly communications and work life and, especially so, regarding any impact it was having on their jobs and careers. Were there, for instance, any signs of AI changing their jobs, giving them more work or, indeed, doing them out of a job?

The secondary aim was methodological: to employ AI, in the shape of Google NotebookLM, for a first pass of qualitative data analysis, with review and oversight by the original interviewers to correct and supplement. This approach allowed a sizeable and complex qualitative dataset to be analysed rapidly, freeing the research team to focus on the interpretive and nuanced work that AI cannot reliably perform.

3 | Scope and Definitions

3.1 | ECRs

There are circulating, various, conflicting, and country-specific definitions of an ECR (da Silva 2021). Our definition is pragmatic: employed in a research position, relatively young, in an early career phase, not yet established as permanent faculty.

Researchers who either have received their doctorate and are currently in a research position or have been in research

positions but are currently doing a doctorate. In neither case are they researchers in established or tenured positions. In the case of academics, some are non-tenure line faculty research employees. Typically, they are young, mainly below 40 years of age, although there are exceptions.

3.2 | AI

AI has no firm or universal definition. Indeed, intelligence of itself is an elusive concept; it tends to have an 'I know it when I see it' quality. No sooner has a task proved amenable to automation than doubt arises: Is that really intelligence? Consequently, when asking about attitudes to and anticipations of the place of AI, it is necessary to consider—'what do you mean by AI?' We have previously found that even quite unremarkable word processing tools were considered 'AI' by some of our respondents (Clark et al. 2025). Furthermore, the scope of 'AI' is inevitably biased by a contemporary interest in Generative AI and Large Language Models, thus only a subset of what may be considered as AI. To put it simply, in the contemporary context, much discussion of 'AI' is about the capacity to generate a plausible text and image—a convincing and realistic fiction. The process is statistical; the output text is plausible because the words are arranged in ways that match the probabilities derived from the training input. But the process is occult; there is limited facility to determine, verify or analyse the logic or 'reasoning' of the process. Contrast that with symbolic AI, autonomic and mathematical models, where there is an 'audit trail'—an algorithm that may be verified or an activity that can be tested and demonstrated to work. Thus, with Generative AI, we can only judge what is presented: truth or fiction?

4 | Literature Review

ECRs, repeatedly found to be the most vulnerable cohort in the research workforce (Burton and Bowman 2022; Loveday 2018; Skakni et al. 2019; Vatansever 2020; Willson et al. 2025), may be facing a worsening of their already precarious job position because of the AI-driven, all-pervasive developments of the past few years. Indeed, while the transformative force of AI is widely believed to be of significant benefit, it also gives rise to concerns regarding the technology's potential to disrupt the workplace, so much so that workers might even lose their jobs (García-Peñalvo 2023; Renkema and Tursunbayeva 2024).

Thus, for example, in a 2024 survey of some 38,000 working adults on six continents, while a plurality of respondents believed AI would have a positive impact on their work, with 17% strongly agreeing and 33% agreeing with the notion, they also had significant concerns: 21% of them said that they were scared that their job would be replaced by AI, and an additional 10% even felt strongly about the possibility (ADP Research 2025). By the same token, in a survey of 14,751 Gen Zs and 8731 millennials from 44 countries, although the participants were largely positive about AI, with more than half of the participants in both groups already using AI-driven technologies for work purposes, they also worried it would reduce available jobs and make it harder for young people to enter the workforce in the future (Deloitte Global 2025).

Indicative of the continuing ambivalence characterising the attitude towards AI in the workplace, a recent survey of roughly 21,000 adults aged 18+ in 21 countries found an ongoing rise in AI usage amid uncertainty over the impact AI may have on the job market. Thus, over half of the respondents in 20 of the 21 countries reported that they had used an AI application in the previous 12 months—66% average across all 21 countries, up 18% from 2024 and 28% from 2023. However, while 50% of the respondents felt that the usage of AI in the workplace would create new jobs and ultimately help workers, another 50% thought that the technology would eliminate jobs and ultimately hurt workers (Google/Ipsos 2026).

The scholarly community, the epitome of knowledge workers, as their *raison d'être* is producing new contributions to the human body of knowledge, is a prime example of a sector in which both appreciation of AI and concerns about the job-related implications of its use are bound to be acutely felt. This is hardly surprising, of course.

On the one hand, as literature-based analyses of the state of the integration of AI into the scholarly undertaking indicate, scholars are greatly incentivised to embrace AI-driven technologies, as these have been recognised as capable of boosting research productivity—the key to scholarly success in terms of employment, tenure, promotions, resources, job mobility, awards/prizes and monetary remuneration. Indeed, AI affords scholars unprecedented opportunities for creativity, efficiency and accessibility over the full range of the research tasks they perform, from idea generation, literature review, study design, data generation and analysis, to writing the actual manuscript, even to automated manuscript triage and AI-assisted peer review (Herman et al. 2024; Musslick et al. 2025; Van Quaquebeke et al. 2025). Take just one example that demonstrates the extent to which AI's footprint is discernible in the ways that research is conceived, executed, published and shared: a recent Elsevier (2025) survey of 3200 researchers across 113 countries found that researchers are currently using AI tools to find and summarise the latest research (61%), perform literature reviews (51%), analyse research data (38%), draft grant proposals (41%) and draft research papers or reports (38%).

On the other hand, as Zarifhonarvar (2024) suggests based on the literature published on the topic, while AI can create new job opportunities, particularly in high-skilled jobs, its eminent suitability to automation of simple knowledge operations may lead to job displacement, too, particularly in the case of routine tasks. This, in turn, can result in unemployment, wage stagnation and an increase in income inequality. Obviously, with all that research work based chiefly on advanced cognitive abilities and/or innovative problem-solving skills, routine tasks are so much an integral part of it, too, that 'being replaced by a robot' may seem an understandable concern. Indeed, although higher education levels have been associated with lesser apprehension towards AI (Vasiliu and Yavetz 2026), scholars, too, are simultaneously hopeful about the effects of AI on the way they conduct their work and wary of its consequences for their employability and ability to hold on to their jobs (Valentini and Blancas 2025).

This situation must be even more characteristic of junior researchers' circumstances, although there appear to be no studies exploring specifically ECRs' views and practices as they are facing the dilemma of embracing AI technologies despite fears of being replaced by them. However, idiosyncratic factors in ECRs' work-life can explain why, in their case, scholars' above-noted ambiguous approach to AI may be particularly pronounced.

First, with research productivity being the powerful driving force that it is behind researchers' endeavours, it is doubly so where ECRs are concerned. Focussed as they need to be, and, indeed, inevitably are, on gaining entrance into the scholarly world via increasing and accelerating their productivity, they are likely to be receptive to AI-based tools, as these can help in the fast accumulation of scientific capital in terms of traditionally defined stellar research achievements (Herman et al. 2024). Indeed, usage data obtained from the latest round of the *Harbingers* project, conducted in preparation for a full-blown study on ECRs, although based on a relatively small, convenience sample, already indicate that in the case of novice scholars' research undertakings, AI is impacting on a very wide front (Clark et al. 2025; Nicholas et al. 2024, 2025).

Beyond that, the decision to opt for AI (or not) may very well be age-associated. According to the 2024 survey of some 38,000 working adults on six continents (ADP Research 2025), when it comes to novice workers in general, the younger the worker, the more likely they were to show both optimism and concern about AI, conceivably as they are bound to take a long-term view of their careers. Indeed, late-career workers, especially those 55 and older, seemed to show the most indifference towards AI, possibly in view of the limited number of years remaining in their jobs.

In the scholarly world, too, the younger cohorts were found to be more enthusiastic supporters of AI-powered tools. For example, an early exploratory study into the use of ChatGPT in education, research and healthcare already showed that junior academics were not only more interested in using the technology than senior faculty, but more of them had already tried it, too (Hosseini et al. 2023). Similarly, in another early study, a *Nature* survey of postdocs, 31% of employed respondents reported using chatbots, with 43% of them doing so on a weekly basis and 17% daily, even if for most (67%), AI brought no change in their day-to-day work or career plans (Nordling 2023). More recent findings also indicate that PhD students and early-career academics are the highest adopters of AI for research purposes; indeed, they are the most willing to experiment with these new technologies (Mohammadi et al. 2026).

This is perhaps not very surprising, for, as it has long been established, it is the natural inclination of today's young people, as digital natives born into an internet-centred and media-rich world, to opt readily for any new digital technology (Prencsy 2001a, 2001b). Still, the jury may still be out when it comes specifically to the relationship between age and the fear of being replaced by AI technologies in the workplace. According to the findings of Vasiliu and Yavetz (2026), at least in their Israeli sample, older individuals were more likely to

report less fear of being replaced by AI in their jobs, possibly because they possess a certain level of adaptability or resignation towards technological changes.

Finally, and possibly most importantly, another factor that may also come into play is that ECRs are, obviously, on the bottom rung of the academic ladder. According to forecasts about the impact of AI on broader sections of the working population, it is entry-level jobs/positions that will be hit hardest (Ravio 2025). The developments on the ground certainly lend support to the validity of the trends forecasted. Thus, in the United States, early-career workers (ages 22–25) in the most AI-exposed occupations have experienced a 16% relative decline in employment since the widespread adoption of generative AI, while employment for workers in less exposed fields and more experienced workers in the same occupations has remained stable or continued to grow (Brynjolfsson et al. 2025). Similarly, in the United Kingdom, the number of new entry-level jobs has dropped by almost a third since the launch of ChatGPT, as companies use AI to cut back the size of their workforces (Almeida 2025). It follows then that newcomers to the academic community, many of whom are still PhD students and postdocs, could be particularly prone to hiring freezes, layoffs, job replacement and changes to the work they do.

Complicating things even further is the above-noted commonly held belief that AI poses more of a threat to workers in routine roles (Zarifhonarvar 2024), indeed, in occupations where AI is more likely to automate, rather than augment, human labour. Typically, it is ECRs' lot, as the veritable 'workhorses' of the scholarly undertaking, to perform the more routine tasks involved in a research project, such as the reviewing of the literature (Baker 2020). It is quite conceivable then that they may find themselves replaced by AI-powered tools, certainly more so than their more senior colleagues.

Apparently, then, with all the hype surrounding the potential of AI to play a central role in research, the scarcity of empirical evidence when it comes to ECRs means that we simply do not know yet whether they will manage to harness AI to their practices or whether they are doomed to being marginalised. As Renkema and Tursunbayeva (2024) suggest, there are two possible scenarios of future developments: an optimistic one and a pessimistic one. In the optimistic scenario, AI technology advances significantly to become a powerful tool that enhances academic work and knowledge creation. In the pessimistic scenario, though, the academic community becomes divided, with a significant portion resisting AI integration due to ethical concerns and fear of job displacement, so that progress and collaboration in knowledge creation and dissemination will be hindered. Is AI then, going to be more of a threat or benefit to ECRs? This situation would appear to call for the kind of investigation we are conducting here.

5 | Methodology

5.1 | Recruitment of Interviewees

National interviewers (from Malaysia, Poland, Portugal, Russia, Spain, the United Kingdom and the United States) recruited ECRs, using their local research networks/connections

and, importantly, from previous cohorts of ECRs (32 were recruited this way). For this exploratory phase of the project, each country was allocated a potential quota of interviewees (10–11). Malaysia, Poland, Portugal and Spain recruited 10 interviewees and Russia 11, but resource and time constraints led to a merged UK/US 'international' group including a British ECR working in Ireland, a Romanian working in the Netherlands, an Australian who had worked in the United Kingdom, a Canadian working in the United Kingdom, plus a German and an Italian ECR. This international group consisted of 11 ECRs and tended to have more ECRs with reasonably secure jobs.

Given practical constraints of cohort size, our interviewer's capacity to balance age, gender and subject was limited; thus, this was very much a purposive and diverse sample. The breakdown of the ECR cohort by country, discipline, gender and age-band is given in Table 1. Note especially the age of the cohort, which, although balanced in terms of age bands, saw one in five ECRs being 40 or over. There are two reasons for this. First, we retained ECRs from previous stages of the project; they were all a year or two older. Second, it is the nature of academic, or indeed any employment, that not everyone moves forever upward, and jobs are difficult to obtain. We had more women than men and more scientists with a relevant interest in the topic.

Standing back, the main characteristics of the whole cohort were:

1. The median age of an ECR was 34.
2. The Polish cohort was very female.
3. There were more humanities ECRs in the cohorts from Poland, Russia and the UK/US cohort.
4. Malaysia had more hard social sciences.
5. Spain and Russia had more soft social scientists.

Given the exploratory nature of the research and the relatively small numbers involved, breaking down the data by demographic must be accompanied by a warning sign.

5.2 | Interviews

As with all Harbinger studies, semi-structured, free-flowing, conversational-style interviews (conducted both remotely and face-to-face) lasting 60–90 min were the main source of data, and this was supplemented by the in-country knowledge of the local interviewers, who were in the main established researchers in their own countries. 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. However, as mentioned, there were no direct questions on employment prospects or challenges. A copy of the full schedule can be found on the CIBER website² and what proved to be the most relevant questions to the topic are listed in Table 2.

TABLE 1 | Demographic breakdown of the ECR purposive and diverse sample in 2025.

Discipline										
	CHEM	ENVIR	HUM/ARTS	LIFE	MATH	MED	PHY	SOCH^a	SOCS^b	Total
<i>N</i>	4	5	12	4	5	5	5	7	15	62
%	6	8	19	6	8	8	8	11	24	100
Country										
	ES	GB/US/Int^c		MY	PL	PT	RU	Total		
<i>N</i>	10	11		10	10	10	11	62		
%								100		
Age										
	Youngest (26–30)	Younger than most (30–34)		Median (35–37)	Older than most (37–39)		Oldest (40–51)	Total		
<i>N</i>	12	13		12	13		12	62		
%	19	21		19	21		19	100		
	Male				Female			Total		
<i>N</i>	27				35			62		
%	44				56			100		

^aIncludes Economics and Business, Geography and Psychology.

^bIncludes Anthropology, Politics and Sociology.

^cThis is really a composite international grouping including a British ECR working in Ireland, a Romanian working in the Netherlands, an Australian who had worked in the United Kingdom, a Canadian working in the United Kingdom, a German and an Italian ECR.

5.3 | Data Analysis

All interview transcripts, having been read and approved by the interviewees, were translated into 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. Thus, the coding sheets were multi-faceted, containing quantitative and qualitative responses to questions, in particular direct quotations and occasional explanatory comments from the interviewers. The data were subject to two forms of analysis.

5.3.1 | AI Analysis

Google's NotebookLM was chosen speculatively: it was readily accessible, we tried it, and it worked. Overall, it turned out to be a useful tool. Its analysis is grounded in our own uploaded data, so it is relatively easy to verify observations and assertions against our own sources.

The full text of quotes and comments for every question, and where relevant, encodings plus a statistical summary of the coded responses was uploaded to NotebookLM and it was prompted to focus on the topic of particular interest: 'Do the Early Career Researchers (ECRs) interviewed here consider Artificial Intelligence (AI) as, on balance of probabilities, an opportunity or a threat to their future career?' This was then shared with all national interviewers to see what they thought of the analysis by checking the interview transcripts thoroughly to see whether it was correct and trustworthy. This was a general

report covering the entire data set. To help them in their assessment and be better able to spot flaws, a second set of reports limited to only *their* set of interviews was prepared. Thus, each generated report was reviewed in the context of first-hand and unique knowledge.

We asked our interviewers to look out specifically for anomalies, inaccuracies, and that subjective 'uncanny valley'—the intuitive sense of something not quite right. We also sought an overall impression of how good, how plausible, the report was. As a guide, we suggested rating with a proviso that this should be assessed relative to an intended audience, in our case: is this at least good enough for post-grad work? The scoring scheme is provided in Table 3. [Please refer to Appendix A for the detailed assessment.]

5.3.2 | Keyword Analysis

There were no direct questions on the topic to analyse, but we conducted a keyword search of the entire database for mentions of employment, job loss, opportunities, prospects, careers and variations of these terms to see what we could find of relevance. Those are comments that had been volunteered in answering other questions. Four questions yielded relevant and interesting comments, and these are analysed in Section 6.

5.3.3 | Desk Research

National interviewers were asked to provide general comments on employment and career opportunities in each country to provide context and explanation for their interview

TABLE 2 | Interview questions potentially yielding relevant data on job security and change.

Broad topic	Question asked
General	<p>Awareness of AI: Experience and Encounters; Engagement; Utility; Reservations.</p> <p>Are you concerned about the use of AI in any way? If so, why?</p> <p>If AI is seen as a transformative force, in what ways will it reshape academic practices, research and knowledge dissemination?</p> <p>If current AI developments bring big changes, how soon: now, in a year or two, this decade, in your working lifetime?</p> <p>Are you currently aiming for a permanent academic career in a university or similar research organisation? If not, what do you intend</p>
Reputation	Can AI help in reputation building?
Skill development	<p>Have you tested or considered AI-based tools for research work? What may be the benefits or problems involved in using AI for research?</p> <p>Are AI-based tools a regular part of your research work?</p> <p>How far does reliance on technology weaken fundamental skills? Can developing new technological skills compensate for this loss?</p>
Authorship, publishing	<p>Have you used AI to make a first draft, recast or rewrite your own (original) text?</p> <p>Are authorship policies likely to change because AI has the potential to become a 'ghostwriter' (another author)?</p> <p>Machine learning is only as good as the data used to train it. Thus, large language models may have embedded biases, assumptions, etc. Do you think these are essentially different in scope or kind to similar limitations in conventionally published research material?</p> <p>AI could increase productivity but lower quality; how is scholarly integrity to be maintained in these circumstances?</p>
Outputs, integrity and ethics	<p>Do you believe that the AI-associated potential for rapid production of scientific articles leading to a decline in the overall quality of research output?</p> <p>If current AI developments bring big changes, how soon: now, in a year or two, this decade, in your working lifetime? Ethical implications?</p> <p>Do you believe that AI is introducing new challenges related to scholarly integrity and ethics?</p>

results. Most have been part of our team studying ECRs for a decade.

6 | Results

The AI-assisted analysis and the interviewers' assessments are summarised in the text below; the original NotebookLM report and the country-by-country interviewer assessments are reproduced in full in Appendix A. The keyword analysis of ECR comments on jobs and careers follows as Section 6.1.

The AI analysis (NotebookLM) identified six principal thematic clusters bearing on ECR employment and careers: changes in skill requirements and job roles; intensified publication pressure and quality concerns; intellectual property and authorship issues; impact on academic recognition and evaluation; the competitive landscape and inclusivity; and the impact on peer review. Across these themes, the overall picture was of a double-edged sword: AI streamlines workflows, reduces barriers to publishing and can democratise access,

particularly for non-native English speakers; but it simultaneously threatens research quality and integrity, raises questions of attribution, risks devaluing routine tasks performed by ECRs, and may intensify competition for entry-level positions by expanding the pool of applicants. The AI analysis concluded that the prospects of ECRs will depend chiefly on whether institutions, publishers and individuals prioritise ethical use and critical oversight rather than speed and volume. The national interviewers reviewed the AI-generated report against their own knowledge of the interview data. The general verdict was that the analysis was plausible, impressively rapid, and well-suited to identifying broad themes. Its principal limitation, consistently noted across countries, was over-generalisation: single-respondent observations were liable to be presented as if they reflected a collective pattern. We also identified at least one substantive omission (plagiarism detection as a distinct opportunity theme, noted by five Malaysian ECRs) and restored important nuances of voice and individual differences that the AI had flattened. The full NotebookLM report and the interviewers' detailed country-by-country assessments are provided in Appendix A.

TABLE 3 | Rating scheme for assessing NotebookLM-generated data.

Score	Assessment	Explanation
*	= fail	Obvious errors (contradiction, not 'common-sense', etc.). Even a non-expert can see flaws.
**	= poor	Errors noticeable by someone familiar with the subject.
***	= passable	Coherent and plausible. No apparent errors or nonsense, but bland, generic, non-specific, a consensus. Nothing you do not already know. Possibly beguiling and superficially persuasive.
****	= perceptive	Some original observation, dug a little deeper could seem five-star to the non-expert.
*****	= understanding analytic, beyond the surface	Real insight.

6.1 | Keyword Analysis: ECR Comments on Jobs and Careers

As mentioned, there were no direct questions on the topic of job precarity, but some questions had the potential to stimulate relevant comments (see Table 2), so we undertook a keyword search of the entire database for mentions of employment status, careers, and variations of these terms to see what we could find. Sixteen questions yielded some information and around a dozen relevant and interesting comments, adding another dimension of personality and detail to the overarching analysis.

First, this comment from a Polish soft social scientist, referring to a broader world than academe in answering the question: 'What is your awareness of AI: Experience and Encounters; Engagement; Utility; Reservations':

I have several experiences. I am game studies scholar, I participated in projects that wanted to utilise LLMs as well as I used some of it for fun in the past. I know a lot of people, that lost their jobs and income to AI, mostly because they were illustrators, animators and copywriters and other creators.

A Spanish hard social scientist answering a different question, 'Are you concerned about the use of AI in any way' said they were worried about:

the impact on employment and creativity if human processes are replaced without a complementary approach.

A British soft social scientist answering the same question raised the entry-level threat posed by AI:

I'm also worried, of course, about the effect it has on the job market and how a lot of companies probably think they can replace entry level positions with AI, and that, you know, means that a lot of people don't, cannot start their career. So, I am worried at this more kind of general level.

A British medical scientist felt that their work could not be replicated by AI, but still had worries about the absence of human input:

I think, as anything, when you start something new, it's just like, Oh, God! Here's another thing to learn. Here's more work to do, but I know that it will probably be streamlining in the future. I don't think I've got the kind of job that I can be replaced by AI, so I don't mind it too much. I'm not worried from that perspective. I think it worries me that sometimes people won't add the sense check of human input. But using it within its bounds to supplement existing work (and remove some of the menial tasks) can only be beneficial in my opinion.

Finally, regarding the same question, a Polish soft social scientist, unusually, felt that it was creative jobs that were also at risk:

I know that in spirit of optimising and productivity a lot of people will use it without any reservation and it will be supported by powers that be, because it will lower some costs, however it will not outsource a menial work, but most likely – it will take away creative jobs and replace it with a slop.

Regarding the question: 'If current AI developments bring big changes, how soon: now, in a year or two, this decade, in your working lifetime?' a Malaysian hard social scientist explained which jobs they felt were most threatened:

I don't feel my job as in academia at risk, but I can see why some might worry, especially those in publishing like editing, proofreading, journal managers, or even marketing or research support, like RAs (research assistants) or research officers. AI can speed up tasks like writing or summarizing, which might make some positions feel less essential.

Another Malaysian, a physical scientist, answering the same question, however, saw a very rosy future for ECRs AI was going to big a huge help:

Some tasks are perfect for AI assistance, like drafting grant proposals, filling out ethics applications, compiling progress reports. These tedious jobs could free us up researchers to focus on big-picture

thinking and creativity. I'm pleased with real-time AI translation, could break down language barriers for good. A groundbreaking study published in Mandarin today might be instantly accessible in Spanish, English, or BM (Malay) tomorrow. Democratizing knowledge! The transformational force—not just faster or more efficient; it's smarter, more inclusive, and more collaborative. But through it all, of course the human touch remains irreplaceable. AI can suggest, but humans decide. It can analyse, but we interpret. As what we say, the future of academia isn't machines or humans—it's machines and humans, each do what we do best.

Moving finally to the last question that produced interesting results, which asked 'How far does reliance on technology weaken fundamental skills? Can developing new technological skills compensate for this loss?'

This comment from a Spanish soft social scientist suggested it was a case of 'the boy that cried wolf'—there is nothing to worry about:

Well, I don't know to what extent it weakens skills, but it's clear that technology is still a tool, so, first and foremost, we must use it responsibly and effectively. Perhaps it can lead to greater dispersion, but I often believe that these messages about the dangers of technology are nothing more than reactionary approaches to its advancement. If the use of technology really leads to greater dispersion or loss of concentration, it could be offset by technological skills. I think it could also be an opportunity to advance science more quickly.

A British chemist thought similarly, although admitted some jobs could go:

No, I don't think so. I think in the end you still must feed it something, and you have to feed it something, effective that it can work with, and that's still something that we create with our own skills. In the end, AI is just a language model, right? AI is already being overblown. It's a complex analysis tool, right? And then it can spit it back out at you. So, anything that happens is it just makes your skills more efficient. You know, it could replace the number of people required to do a job, because now you've got less humans and less errors from the humans. But the kind of creative, analytical aspects, no.

7 | Discussion and Conclusions

Our primary aim was to get an early insight into the impact AI was having on the jobs and careers of ECRs, and our principal

source of data was a purposive and diverse sample of more than 60 deep, open-ended interviews we undertook with international ECRs from a wide range of subjects and countries in 2025. Our sample size was not to achieve balance, but to ensure inclusion of voices from a variety of academic systems (seven countries) and disciplines. In qualitative research, we select for insight, not representativeness.

Three forms of investigation were conducted to this end: (1) an exploratory use of a relatively new AI tool (NotebookLM) to analyse and summarise many hours interview data; (2) country interviewers were asked to comment on its veracity and add the missing detail and nuance; (3) a more 'traditional' keyword analysis of the interview database sought to identify relevant ECR comments to provide a personal and human element to the study. Altogether proving us with an all-round snapshot.

Turning to the NotebookLM analysis. We used it not as a separate object of study, but as a necessary methodological tool to manage and analyse a complex, contemporary dataset for this purpose. All primary data were generated, transcribed and initially coded by the research team, with NotebookLM employed to support data organisation, retrieval and iterative sense-making across a complex and contemporary dataset. Our assessment of its capabilities is presented as an integrated transparency and reflexivity exercise, vital for justifying the rigour of our substantive conclusions. The NotebookLM analysis concluded that 'Overall, interviews reveal a complex landscape where AI is seen as a powerful tool that demands careful consideration of ethics, quality, and human oversight within scholarly practices. Clearly and inevitably ECRs face challenges regarding job security and opportunities and AI is yet another one, maybe the biggest one or maybe it is a double-edged sword?' Perhaps, the biggest and most worrying challenge is that AI's ability to streamline application processes could lead to a 'bigger pool of people' applying for jobs, making the academic market even more competitive for ECRs.

While none of the interviewers would disagree with these sentiments and generally commended the clarity, quality and balance of the thematic analysis, it was also agreed that there was a tendency to overgeneralisation.

Hence, there is a need to go deeper, to individual country reports and keyword analysis. Here we found that scholarly communications jobs (i.e., those in publishing) were regarded as at greater risk than those of researchers. Generally, ECRs were more positive than negative about AI; it will change the nature of research work, but is unlikely to make ECRs redundant. However, deep in the interviews, there lurks some worries concerning risks to repetitive jobs and, indeed, creative ones as well. And, the very fact that all country interviewers were impressed by the NotebookLM report raises the question: if it seems this might be 'good enough', then might it present a case that AI will be making ECRs redundant sooner than you think?

The interviews raised interesting, at times unsolicited points, which we submitted to a preliminary examination with the express purpose of pinpointing the specific questions that need to be explored in a full-blown study.

NotebookLM was employed for qualitative analysis with human oversight, as described in the methodology.

In conclusion, then, our study drew on a purposive and diverse sample of limited size to inform a larger investigation; the findings should be interpreted as exploratory, offering valuable insights and addressing a genuine gap in the literature rather than providing definitive conclusions. It is not a pilot study, which is explicitly methodological in purpose. The study is substantive, to generate insights, not merely test procedure; it is about what we can learn at this stage, and how it shapes the next phase. What matters to us is intent and contribution, not scale.

Author Contributions

David Nicholas provided oversight of the article and wrote much of it. David Clark was responsible for methodology. Eti Herman did the literature review and helped with the conclusion. The rest of the authors (Abdullah, Akeroyd, Revez, Rodriguez Bravo, Swigon, Polezhaeva and Gere) undertook their country analyses and provided general feedback.

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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. AI (Google NotebookLM) was used in the qualitative analysis of the interview data. The AI-generated analysis was reviewed and verified by the national interviewers, each of whom checked the output against their own first-hand knowledge of the transcripts they had produced. The full draft paper was reviewed by the whole research team prior to submission. The use of AI in analysis was not part of the original consent process: at that time, because of its novelty, there were no established norms requiring consent for this innovation.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

¹According to Perplexity.ai Based on available data and membership rates across major fields and continents, the best estimate is over one million ECRs globally.

²<https://ciber-research.uk/harbingers-4/index.html>.

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Appendix A

NotebookLM Report and Interviewers' Assessments

The following two sections reproduce, first, the full report generated by Google NotebookLM when prompted to analyse the interview data on the topic of AI as opportunity or threat to ECR careers, and second, the detailed assessments of that report by the national interviewers. These are provided here as supplementary documentation. Commentary on both is incorporated in the main text (Section 6.1).

The Summary Generated by NotebookLM

This is the original text generated on 24 July 2025 using a source document (H4G-ALL-FT.pdf) containing all the ECR quotes and interviewer commentary from the fourth round of Harbingers interviews. Subsequently, further versions were generated using localised subsets of the interviews. Our commentary in the main text is therefore a consolidation of the various versions. The somewhat eccentric formatting here is as in the original.

Prompt used: *Summarise the quotes in this document with particular relevance to the potential effect on the employment prospects for Early Career Researchers (ECR).*

The potential effect of artificial intelligence (AI) on the employment prospects and careers of ECRs is a complex and multifaceted topic, as highlighted by various perspectives in the sources. While AI is seen as a transformative tool that can offer significant benefits, it also presents substantial challenges and risks.

Here's a summary of the potential effects:

1. *Changes in Skill Requirements and Job Roles:*
 - a. *Shift in focus:* ECRs may transition from primarily engaging in manual data collection and analysis or extensive writing tasks to becoming 'skilled interpreters of AI-generated insights'. This new role demands competencies in prompt engineering, coding, and advanced theorising, blurring traditional academic boundaries.
 - b. *Risk of skill erosion:* There is a significant concern that over-reliance on AI could diminish fundamental skills such as critical thinking, logical analysis, independent writing, nuanced understanding, memory, and direct communication. Researchers emphasise the importance of maintaining human functionality and foundational knowledge, even if AI tools become ubiquitous.
 - c. *Devaluation of certain tasks:* AI's ability to quickly generate sections like introductions, theoretical frameworks, or literature reviews might reduce the perceived value of human effort in these areas, which are often foundational for ECRs.
 - d. *New opportunities:* AI can also enable ECRs to enhance their visibility and professional networking through automated content creation for social media and communication. It can streamline research processes, freeing up time for more creative and critical thinking.
2. *Intensified Publication Pressure and Quality Concerns:*
 - a. *Increased output:* AI tools can dramatically accelerate literature reviews, data analysis, and drafting, making it easier for ECRs to produce more papers at a faster rate. This can exacerbate the 'publish or perish' culture that already pressures ECRs.
 - b. *Risk to quality and integrity:* The ease of content generation, if unchecked, could lead to a prioritisation of quantity over quality, resulting in 'slop papers', 'watery papers', or 'academic junk food' that lack depth, originality or rigorous validation. This could erode trust in academic work and make it challenging for ECRs to distinguish high-quality contributions.
 - c. *Detection challenges and plagiarism:* AI-generated text is becoming increasingly sophisticated and harder to differentiate from human writing, raising concerns about undetectable plagiarism, 'AI ghostwriting', and fabricated citations. ECRs, especially those with less experience, may be particularly vulnerable to falling victim to or inadvertently engaging with predatory publishing practices and paper mills, which AI can exacerbate.
 - d. *Bias perpetuation:* AI models trained on publicly available, potentially low-quality, or biased data (including predatory publications) risk perpetuating misinformation and biases, metaphorically 'polluting the well' of knowledge. ECRs must be vigilant in verifying sources and exercising critical thinking.

3. **Intellectual Property and Authorship Issues:**
 - a. *Ambiguity in ownership:* A significant challenge lies in defining authorship and intellectual property rights when AI is involved in content generation. There are calls for new attribution models and clear legal frameworks.
 - b. *AI as a tool, not author:* The consensus among researchers is that AI is a tool, like a pen or calculator, and should not be credited as an author. However, there is a growing demand for transparency, with many institutions and journals requiring disclosure of AI tool usage in manuscripts.
4. **Impact on Academic Recognition and Evaluation:**
 - a. *Continued reliance on traditional metrics:* Citations, publications in indexed journals, and grants remain crucial metrics for academic reputation, evaluation, and career progression (e.g., promotion, tenure and securing funding). AI's influence on these metrics (e.g., through publication speed) is a notable point of discussion.
 - b. *Potential devaluation of traditional publications:* Some foresee a future where the sheer volume of AI-generated content might devalue traditional journal publications, shifting focus to the *usefulness* and *societal impact* of research or increasing the prominence of informal channels like preprints and social media. This could impact how ECRs build their CVs and gain recognition.
 - c. *New evaluation criteria:* The evolving landscape suggests a need for new evaluation frameworks that consider AI's role and broader impact, such as social media mentions and real-world applications alongside traditional metrics.
5. **Competitive Landscape and Inclusivity:**
 - a. *Digital divide:* A risk of creating "huge inequalities" between ECRs who have access to and master AI tools and those who do not, potentially creating a significant competitive disadvantage in productivity and visibility.
 - b. *Increased accessibility and inclusivity:* On the positive side, AI can lower barriers for non-native English speakers or those in institutions with limited access to expensive editing services, potentially democratising publishing opportunities for a wider range of ECRs globally.
 - c. *Increased competition:* AI's ability to streamline application processes could lead to a 'bigger pool of people' applying for jobs, making the academic market even more competitive for ECRs.
6. **Impact on Peer Review:**
 - a. AI could assist peer review by detecting plagiarism, checking references, or identifying formal errors
 - b. However, there are concerns that AI could undermine the critical, substantive aspect of human peer review, leading to superficial evaluations. There is also a strong call for compensating human reviewers to incentivise thoroughness and maintain quality.

In conclusion, AI presents ECRs with a double-edged sword. It offers the potential to streamline workflows, enhance productivity, reduce barriers to publishing and increase research accessibility and impact. However, it simultaneously introduces significant challenges related to maintaining academic integrity, ensuring research quality, redefining authorship, mitigating biases and adapting to rapidly changing skill requirements and evaluation metrics. The future prospects for ECRs will largely depend on how institutions, publishers, and individual researchers adapt to these changes, prioritising ethical use, critical oversight, and the cultivation of uniquely human intellectual contributions, rather than simply embracing speed and quantity.

Like a rapidly flowing river, AI can powerfully propel research forward, carrying ECRs to new discoveries with unprecedented speed. But without proper navigation and ethical dams, it risks eroding the very

foundations of scholarly integrity, leaving behind a barren landscape of diluted knowledge.

National Interviewers' Comments on the NotebookLM Analysis

Overall, it was felt that the report looked very impressive, highly plausible and good at spelling out the themes, though less good at highlighting differences or identifying especially interesting cases or the abnormal or unusual. It also seems to have broadened the original brief going beyond the job threat and covering the related concerns of 'polluting of the well' and traditional metrics as well. Much of it concerns threats to research generally, which, of course, is relevant. However, it could only work with what we gave it, and as mentioned, we did not have any direct questions on the topic. It shows that the general judgement was impressive, with Spain rating it highest and Russia the lowest, but still a passable score (Table A1).

The interviewers were asked to comment freely on the NotebookLM output against their own knowledge of the data, with no prescribed format, and their detailed individual responses are provided in full as Supporting Information alongside the NotebookLM report itself. The following summarises the principal human inputs and the corrections they produced. All interviewers found the AI-generated analysis plausible and impressively rapid. The main substantive correction introduced by human oversight was the consistent identification of over-generalisation: the AI tended to treat single-respondent observations as indicative of broader patterns. For instance, interviewers in Poland and Portugal independently noted that claims about job displacement or peer-review concerns rested on single references in their respective datasets, yet appeared in the AI report as if they represented a shared tendency. The Malaysian interviewer identified an additional theme entirely absent from the AI output—plagiarism detection, raised explicitly by five ECRs—and corrected instances where the tool had collapsed distinct terms ('tool', 'assistant' and 'friend') into a single characterisation, losing authenticity of voice. The Russian interviewer noted that the AI missed individual moments of real interpretive interest, such as a respondent whose attitude to technology combined logical analysis with an almost shamanistic cast of mind. The British interviewer observed a stylistic uniformity in the AI output that, in their view, made it recognisably machine-generated, and noted that questions of weight—how much significance to assign a given response—remained a matter of human judgement that the tool could not supply. Taken together, the human assessments confirm that the AI analysis provided a sound and efficient first-order synthesis, useful for identifying broad thematic structure, but requiring human correction to restore precision, nuance, and the individual voices that give qualitative data its evidential weight.

Summary

Clearly, everyone was impressed with the content and the breathtaking speed with which it did the job. And it was 'hard-bitten' researchers

TABLE A1 | Country assessments of the NotebookLM on AI impact on ECRs.

Country	Score	Judgement
Great Britain	***+	Between passable and perceptive
Malaysia	***+	Between passable and perceptive
Poland	***+	Between passable and perceptive
Portugal	***+	Between passable and perceptive
Spain	****	Perceptive
Russia	***	Passable

doing the interviews, who knew the data, who thought this. The most critical observation was of overgeneralisation. The sources were restricted so that first-hand knowledge could better detect any misrepresentation. The value of the extended interview format we adopt is that sometimes we can pick out one observation of real significance. As we have developed this study, we have moved away from aggregates—so many percent said this, so many said that—the individual voices count, not how many are counted. The problem, of course, is if you think this might be 'good enough', as most of us thought, then you are making the case that AI will be making people redundant very soon.