The disconnect between researcher ambitions and reality in achieving impact in the Earth & Environmental Sciences – author survey [version 2; peer review: 1 approved, 1 approved with reservations, 1 not approved]

Previously titled: The disconnect between researcher ambitions and reality in achieving impact in the Earth & Environmental Sciences – narrowing the gap

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Abstract

Background: There is an increasing desire for research to provide solutions to the grand challenges facing our global society, such as those expressed in the UN SDGs ("real-world impact"). Herein, we undertook an author survey to understand how this desire influenced the choice of research topic, choice of journal, and preferred type of impact.

Methods: We conducted a survey of authors who had published in >100 of our Earth & Environmental Science journals. The survey was sent to just under 60,000 authors and we received 2,695 responses (4% response rate).

Results: Respondents indicated that the majority of their research (74%) is currently concerned with addressing urgent global needs, whilst 90% of respondents indicated that their work either currently contributed to meeting real-world problems or that it would be a priority for them in the future; however, the impetus for this research focus seems to be altruistic researcher desire, rather than incentives or support from publishers, funders, or their institutions. Indeed, when contextualised within existing reward and incentive structures, respondents indicated that citations or downloads were more important to them than contributing to tackling real-world problems.

Conclusions: At present, it seems that the laudable and necessary ambition of researchers in the Earth & Environmental Sciences to contribute to the tackling of real-world problems, such as those included in the UN SDGs, is seemingly being lost amidst the realities
of being a researcher, owing to the prioritisation of other forms of impact, such as citations and downloads.

Keywords
academic publishing, Earth Sciences, Environmental Sciences, research journals, research assessment, survey, Sustainable Development Goals, SDGs

This article is included in the Research on Research, Policy & Culture gateway.
Introduction
The role that academic publishing plays in the research process is often understood to comprise registration, curation, evaluation, dissemination, and archiving\(^1\). This covers validation (through the peer-review process), publication (participation in the scholarly record), curation (preservation of the work to ensure its availability in perpetuity), and dissemination (to relevant communities). These activities help researchers to advance knowledge by building on existing outcomes, progressing discussion and debate, and driving consensus. However, in the digital age, the potential of a research journal is much broader than this, fostering collaboration, network-building (both within core and adjacent fields), career development, and maximizing the capability of research to mobilise knowledge and contribute to the solving of grand challenges\(^2\). Indeed, especially in the Earth and Environmental Sciences, there is increasing pressure on researchers to support policy formulation or to address societal challenges through their research in order to continue to receive research funding\(^1\). Therefore, it is essential that the mechanisms and drivers that collectively influence where an author chooses to publish their research support publication in the journals that are most relevant to their work; that is, where their research is most likely to be found, read, cited, and iterated upon by those working in the same and adjacent disciplines, as well as by those working outside of academia, in policy-making, lobbying, or advisory capacities. However, such mechanisms and drivers, both personal and external, are varied and nuanced, as are our authors’ expectations for what impact that their work might have once it has been published. Academics\(^3\), institutions\(^4\), publishers\(^5\) and learned societies\(^6\) often survey their researchers and/or members to understand their values and views towards key issues around topics such as open access, data sharing, reproducibility, and career progression\(^7\). Research impact has also been the subject of both surveys\(^8\) and research\(^9\) in recent years, with common themes emerging around the opportunities presented by the move to digital of open access, and of linking research outputs to broader societal impact or benefit. Furthermore, several national research evaluation systems, such as the UK’s Research Excellence Framework (REF)\(^12\) and the Australian Research Council’s Excellence in Research for Australia\(^13\) include the potential societal impact of applications in their allocation of research funding. Conversely, common roadblocks have been identified, including access to outputs, incompatible research culture, and an over-emphasis on journal metrics, rather than individual researcher/research-output impact, which lead to a focus on publishing work in highly ranked journals in order to advance in their careers\(^5\).\(^14\).\(^15\).\(^16\). For example, one of the main findings from Springer Nature’s 2019 research collaboration on researcher attitudes towards societal impact was the focus from survey respondents on the concept of “academic impact”, which was more important to most respondents than “societal impact beyond academia”.

It is in this context that we undertook the 2020 Impact Assessment of Earth & Environmental Sciences Research: Author Survey. Surveys have been frequently used for evaluating “research impact”\(^12\), and there has been much discussion about the relationship with the UN Sustainable Development Goals (SDGs) within the Earth and Environmental Sciences communities\(^17\). Therefore, our survey was particularly designed to achieve three main aims. To understand:

- what drives these communities to choose the topics that they research;
- what drives these communities to choose the journals that they publish in; and
- what type(s) of impact they are most looking for from their work.

We investigated what benefits publishing in our journals could impart on both the research and on the authors following publication, and we looked at to what extent global challenges, such as those expressed in the SDGs and the missions of Horizon Europe, were shaping researcher ambitions.

Methods
In Spring 2020, Taylor & Francis surveyed authors from across our Earth & Environmental Sciences portfolio. The survey (see Extended data\(^a\)), hosted on Alcheme (formerly Survey-Gizmo), was emailed to authors using Salesforce Marketing Cloud. It was sent to just under 60,000 authors and received 2,695 responses (4% response rate).

The survey comprised 23 questions: section A (Q1 & 2) = multiple choice questions to clarify the article that the survey responses related to; section B (Q3 & 4) = multiple choice questions with the option of prose responses relating to the choice of journal; section C (Q5–10) = multiple choice questions with the option of prose responses relating to the downstream value of publishing the article for both the work and the author; section D (Q11–20) = largely multiple choice with the option of prose relating to the impact of the work, the
motivation for undertaking the work, and the ability of the work to tackle real-world problems and influence policy change. Questions 13, 15, 18, and 20 were solely prose responses. Section E (Q21–23) = demographic questions.

A confidentiality and privacy statement was provided on the first page of the survey, which outlined how the data would be used. Consent to participate in the survey was implied by the authors who clicked through to complete the questionnaire after reading this statement and the instructions given in the invitation email. The data are fully anonymized and no sensitive personal data regarding the respondents were collected. To protect the anonymity of the respondents, all prose responses to the free-text questions (questions 13, 15, 18, and 20) have been omitted from the shared dataset, though some comments have been included herein. Written informed consent was not sought due to the low-risk nature of the research.

The survey responses include authors from 102 journals in the Earth & Environmental Sciences portfolio, and the geographical distribution of responses was similar to that of authors in the portfolio. Therefore, we can be reasonably confident that our responses are representative of Taylor & Francis authors in our Earth & Environmental Sciences journals.

Data analysis
Confidence intervals were calculated for certain parts of our analysis in which we compared groups of different sizes, and we are only reporting herein on differences that are statistically significant. Microsoft Excel was used to prepare the tables and charts. Confidence intervals were calculated by using the Creative Research Systems sample-size calculator.

A note about error bars and statistical significance. The country-comparison charts presented in this report include error bars, which plot the confidence intervals for the percentages shown. When making comparisons, error bars are useful as a visual means of demonstrating the range that likely contains the true overall value for each country in the chart. If the error bars for two or more countries overlap, we should be cautious about making substantive conclusions about any differences, because they may not be statistically significant. Therefore, only clearly statistically significant differences are included in the comparisons presented herein.

Terms and terminology
Herein, we have used a series of terms, including “real-world problems”, “global challenges”, “real-world application”, and “real-world challenges” interchangeably to describe the wider societal impact of a piece of research, which typically occurs downstream of further academic advancements. Research impact, more broadly, incorporates both forms of outputs, and the relationship between a piece of work and these outcomes, for both academic and non-academic stakeholders, is complex.

Results and discussion
SDG-relevance of earth and environment research – the current picture
‘Why do researchers undertake the research that they do?’ It is a fundamental question and the answer is multifaceted, varying by career stage, geography, and subject discipline. However, the publication of the Sustainable Development Goals (SDGs) by the UN in September 2015, which had the stated aim of providing a “a shared blueprint for peace and prosperity for people and the planet, now and into the future” , allows us an opportunity to frame the question in such a way that gets to the core of what researchers hope to achieve through their work, that is: ‘do researchers study topics that contribute, either directly or indirectly, to the tackling of real-world problems?’.

Comprising such urgent needs as Clean Water and Sanitation (SDG 6) and Climate Change (SDG 13), and tackling threats to Life on Land (SDG 15) and Life below Water (SDG 14), one might readily anticipate that a high proportion of research in the Earth and Environmental Sciences would have a part to play in meeting the needs expressed by the SDGs. Indeed, 74% of respondents indicated that, in their opinion and based on their understanding of the broader context of their work and the challenges expressed by the SDGs, their research contributed (directly or indirectly) to the tackling of real-world problems, such as those expressed by the UN SDGs (Figure 1). Furthermore, 90% of respondents indicated that their work either currently contributed to meeting real-world problems or that it would be a research priority for them in the future. Therefore, we might infer that, in the Earth & Environmental Sciences, it is a strong research imperative for our authors that their work contributes to the tackling of real-world problems.

Such a high percentage aligns with the perspectives of journal editors in these subject areas, who, in contributing to our recent publication Sustainable Development Goals in the Earth and Environmental Sciences, expounded the variety, breadth, and richness of research that their journals and subject areas have to offer in tackling the challenges laid out in the SDGs.

In our survey, whilst younger researchers were slightly more likely to undertake this type of research (76% of respondents aged under 50 answered ‘Yes’ compared with 70% of respondents aged 50 or older, with resolved confidence intervals), the difference was not very pronounced, thus suggesting that this is a multi-generational aspiration, rather than one solely driven by early-career researchers.

Whilst we have noted that the tackling of real-world problems, such as those expressed by the SDGs, was a strong research priority for respondents, 8% of respondents selected ‘No’ when asked if their work had such implications. As a follow-up question to those respondents, we asked the following: Please could you elaborate on why your research might not necessarily contribute to tackling real-world problems? and asked for prose responses.
Several responses suggested that their work was too highly specialised, fundamental, narrow in scope, or too preliminary to have broad application to a grand challenge, such as an SDG, whilst others suggested that the contribution of the work depended more on the engagement of policy-makers and aligned government politics than on the relevance of the research. This appears to highlight an opportunity gap around the role that journals could play in maximising the capability of research to mobilise knowledge. This aligns with the view of the International Science Council, noting in its 2021 report that “The value of science to national economies and in confronting global challenges demands more efficient processes of knowledge dissemination.”

Comparison of author-led and analytics-led analyses
In addition to qualitative feedback from survey respondents, we also used the Sustainable Development Goals Research Category in Dimensions Analytics to quantitatively analyse the proportion of research published in the surveyed journals that had been linked to one or more of the SDGs.

To facilitate as close a comparison as possible between the datasets, we analysed the Dimensions records for articles published in the 102 surveyed journals between 2012 and 2020, in line with the distribution list for the survey.

Of the 53,890 published articles, 9,096 (17%) were linked to one or more SDGs, with 10,144 SDG links overall. The relative proportion of article tags to the individual SDGs is shown in Figure 2. As might be expected for Earth and Environmental Sciences subject areas, more than one third of the tagged articles were linked to Climate Action (SDG 13; 37%), followed by Affordable and Clean Energy (SDG 7; 16%) and Sustainable Cities and Communities (SDG 11; 13%).

Notably, the proportion of articles that were linked to one or more SDGs in the Dimensions records (17%) was much lower than the proportion of respondents who indicated that, in their opinion, their research contributed (directly or indirectly) to the tackling of real-world problems (74%). While the survey responses and Dimensions analysis did not overlap entirely in the articles they considered, we think that the overlap was significant enough and the difference was pronounced enough to allow us to make a couple of inferences.

Firstly, the structure of a research article does not typically allow for discussion of the broader implications / applications of a piece of research in contributing to grand challenges, such as the SDGs, which makes meta-analysis more difficult and could mask the relevance of the work to a non-academic audience.

Secondly, the ability of analytics/AI tools to link article-level research with broader problems is improving, but remains under-developed, and further learning will be required to appropriately characterise research with more-indirect SDG implications.

Why is addressing real-world challenges a research priority for our authors?
To understand a bit more about the motivating factors that sit behind the decision of our researchers to investigate topics that have application to real-world problems, we asked Why have you chosen to undertake research that contributes to these topics? (Figure 3). The responses to this question presented a clear split between internal drivers—personal interest (62%) and the desire to contribute to addressing real-world problems (78%)—and external drivers, such as encouragement from a university (16%), other collaborators (16%), or improved opportunities to secure research funding (15%), with internal drivers and aspirations being much more significant.

We find it surprising that the influence of institutions (16%) and funders (15%) were only narrowly more influential than coincidence (14%) in prompting research that was skewed towards meeting global challenges.
Ambitions vs reality

We saw the greatest gap between aspiration and reality when we asked what type of impact was most important to our researchers, who were asked to make a maximum of three selections. The most-preferred type of impact was citations from within the same field (69%), coming above contribution to the advancement of research (53%), contribution to tackling real-world problems, such as those expressed by the UN.
SDGs (21%), and input into policy decision-making (19%; Figure 4).

Interestingly, having seen the strong desire of authors to undertake research with real-world application in the earlier questions, when compared with other types of impact, contributing to the tacking of real-world problems dropped to fifth in the list (21%), behind citations from within the same field (69%) and from adjacent/other fields (25%), and achieving a large readership (34%).

We note that some respondents may have felt that citations were a necessary step in contributing to the advancement of research or in tackling real-world problems, through knowledge sharing and discussion, as the reasons for these selections weren’t probed further. This may be explored further in future research.

Input into policy decision-making, where ideas, research, and theory can be put into practice for much of the national-scale change that is required to meet the needs captured by the UN SDGs (19%), placed further down the list, on par with forming new collaborations (19%). Only attention from the press (3%) and attention on social media (3%) ranked lower.

We also considered the extent to which there was overlap between three of the key responses to the question shown in Figure 3: ‘contribution to the advancement of research’, ‘contribution to tackling big real-world problems’, and ‘input into policy decision-making’ (Figure 5). The percentages shown are based on the total number of respondents who selected at least one of these three options.

Of the respondents who selected one or more of ‘contribution to the advancement of research’, ‘input into policy decision-making’ and ‘contribution to tackling big real-world problems’ as one of their top-three most important types of impact, more than half (51%) only selected ‘contribution to the advancement of research’, which indicated that research impact was much more important than policy and real-world impact.

We also noted modest overlap between respondents who selected either ‘input into policy decision-making’ or ‘contribution to tackling big real-world problems’ and ‘contribution to the advancement of research’, and minor overlap between respondents who selected ‘input into policy decision-making’ and ‘contribution to tackling big real-world problems’.

We did not probe the links between these responses further in the survey, although, as discussed above, several respondents who indicated that their work did not contribute to tackling real-world problems cited the necessary engagement of policymakers to achieve this form of impact. Furthermore, many of the responses to the question ‘How could journals or publishers help research to influence the response to real-world problems?’ indicated the need to engage a non-academic audience (see below).

![Figure 4. Most-preferred type of impact (maximum of three selections).](image-url)
Feedback from respondents has indicated two key points:
1) the aspiration of researchers to contribute to the tackling of real-world problems with their work; and 2) an emphasis on citations and readership as primary measures of impact. We wanted to understand what role the choice of journal played in meeting researchers’ aspirations. To investigate this question, and to see if there might be a correlation between the choice of journal and their preferred type of impact, we asked all of the respondents why they chose to submit their paper to the journal that their work was published in (Figure 6).

The predominant factor in determining the selection of a journal was its relevance to the author’s research, and 64% of respondents indicated this was one of the most-influential factors underpinning their choice of journal. Reaching a broader non-academic audience (which we might link to the desire to contribute to resolving real-world challenges) came quite far down the list, with only 6% of respondents noting that this was an influential factor in determining their choice of journal.

Interestingly, although 42% of authors indicated that the journal having an Impact Factor was an important factor in their decision-making, only 8% indicated that they chose the journal because it had the highest available Impact Factor, perhaps indicating that the presence of an Impact Factor was more important than the score itself. Many institutions, policy-makers, and funders are keen to reduce emphasis on the Impact Factor as part of research assessment practices, so there is perhaps a misalignment in the priorities of researchers, as opposed to their institutions and funders.

We also asked whether the respondents had published in their first-choice journal to understand the possible clouding of a correlation between the preferred type of impact and choice of journal by not being able to publish in their first choice. We found that 75% of respondents indicated that they published in their first-choice journal, whilst 19% indicated that it was their second choice and 6% indicated that they had previously submitted their work to more than one other journal. Based on these responses, we inferred that it was reasonable to make the correlation between citation as the preferred form of impact and the importance of a journal receiving an Impact Factor.

Comparing priorities across different geographies
Scholarly communication is multifaceted, with a range of different stakeholders located all around the globe, across both the private and public sectors. Indeed, we found that authors located in different regions placed different emphases on the criteria that shaped their choice of journal, and their preferred types of impact. We discuss below findings from some specific countries or regions with noteworthy responses, and have made all findings available in the supplementary dataset.

*United States.* Fewer respondents based in the United States indicated that having an Impact Factor was an important criterion in determining their choice of journal compared to the overall average (23% vs 42; Figure 7). Of note, this feedback corresponded with the results of our post-publication author survey, which is sent to authors in all subject areas and all geographies. Respondents from the US typically rate that having an Impact Factor is a less-important factor in determining their choice of journal compared with the global average.
Instead, US-based authors placed more value on real-world types of impact than the global average, with a higher proportion indicating that contribution to tackling big real-world problems, such as those expressed by the UN SDGs, was one of the most-important types of impact to them (29%), and a much-higher proportion indicating that having an input into policy decision-making was important to them (34% vs 19% overall; Figure 8).

Recommendation from a colleague (39% vs 26% overall) and the journal’s capacity to reach a broader non-academic audience (13% vs 7% overall) were also deemed to be much more important factors as a means of identifying a suitable journal for US-based respondents, compared to the global average (Figure 9).

China. Responses from researchers based in China largely reflected the overall results, both in the most-important types of impact and in the factors that were deemed important in choosing a journal.
of impact to them and the most-important factors that influence their choice of journal. As in other geographies, respondents from China indicated that receiving citations from within the same field was one of the most-important types of impact for them (72%), followed by contribution to the advancement of research (49%) and readership/downloads (33%).

However, one noticeable distinction was the relative unimportance of having a real-world impact in terms of contribution to tackling real-world problems (10% vs 21% overall; Figure 10) and input into policy decision making (8% vs 19% overall), perhaps because China-based respondents were less likely to have collaborations with groups who were involved in SDG-related activities (8% vs 16% overall; Figure 11).

Conversely, for China-based researchers, the relevance of a journal to their work was a much-more-important consideration (83%) compared to the global average (65%) and compared to authors based in the US (59%) and Europe (49%), whilst whether the journal had an Impact Factor was as important to Chinese respondents (44%) as the overall average (42%; Figure 12).

**Europe (including the UK).** European respondents closely followed the global averages for both the types of impact that were most important and the most-important factors in determining the choice of journal. However, there were two distinct points of divergence.

Respondents indicated that receiving citations from within the same field was the most-important type of impact to them (73%), followed by contribution to the advancement of research (50%) and readership/downloads (33%). Where respondents based in Europe differed was in the prospect of forming new collaborations (24%), which they considered to be a more-important type of impact than for respondents from India (16%) and China (14%; Figure 13).

Interestingly, and perhaps related to the premium placed on network-building outside of their own subject communities, only 49% of respondents from Europe said that the relevance of the journal to their work was a key factor in influencing their choice of publication venue, much lower than all other territories (65% average; Figure 14).

**India.** Respondents from India again closely followed the global averages in terms of the types of impact that were most important and the most-important factors in determining the choice of journal. However, there were two distinct points of divergence.
Compared to the global average, respondents from India placed significantly greater importance on the relevance of the journal for their work (87% vs 65% overall), comparable to respondents from China (83%) and significantly higher than respondents from the US (59%) and the UK and Europe (49%). Similarly, respondents from India placed much greater importance on the journal’s capability to reach their community (30%) compared to respondents from China (12%), the US (15%), and UK and Europe (18%), as well as to the overall average (19%; Figure 15).

Perhaps most importantly, respondents from India indicated that a journal’s capacity to raise their profile was much more important to them (31%) than respondents from the other territories that we considered (UK and Europe 16%, China 14%, US 12%; Figure 16).

Driving real-world impact
Finally, we asked participants the following question: How could journals or publishers help research to influence the response to real-world problems? Answers were provided as prose and our analysis found suggestions clustered around four main improvements to mechanisms around: access, accessibility, communication of outcomes, and timeliness, as described below.

1. Improve access to the latest research, in particular to non-academic/policy-maker audiences, as well as to the underlying code/data.

“Engage closer with non-governmental organisations (environmental and social) – provide greater access to these organisations that are fundamental to achieving the SDGs but do not have the financial resources to enjoy access/membership of the Journals.”

“Provide access to interesting real-world data sets” / “Publish code and data along with papers; special issues focused on practical applications”

2. Improve the accessibility of research by changing the language, style, and format of publications to serve a non-academic audience.
“Prepare readers’ digest versions of relevant articles, in multiple languages.”

“Provide a policy-type document for research papers that tackle real-world problems. Original research paper may be difficult to read by policy-makers.”

“Publish an e-digest of abstracts indexed by problem area. Send it to NGOs and managers in government agencies so they can quickly find articles that are relevant for their issues.”

“Increased use of executive summaries from research papers that are accessible to a broader audience than academia”

“provide support producing infographics and sharing research to non-academic audiences”

3. Improve communication links to raise the visibility of research implications on policy and real-world issues.

“Making more publicity to the “non-scientific world” of the issues that are published in the journals” / “be present at policy events”

“Special editions and workshops (can be via Zoom) to bring people together.”

“Share published papers on social media and create TV shows where scientists engage on current issues.”

“Connections with academic media outlets, like the Conversation etc.”

“They should announce research grants related to real world problems”

4. Better support the publication of research on areas of particular relevance to live policy issues.

“Seek out authors who are also practitioners.” / “By opening spaces for discussion among different actors (policy-makers, civil society and academia) and societal sector”

“Be willing to publish applied work, not just academic studies.” / “encourage and publish more transdisciplinary research”

“By staying focused on their journals’ scope which should be specific to these real-world problems”

“By planning special issues which focus on research that are in response to real-world problems. When doing so, ensuring that enough time is given for research in this area to be specifically conducted, and not expecting that data is already available to be tailored into a paper that addresses these issues.”

“By considering articles that address real world problems, even if they are not considered “high impact” or “potentially citable”.”

In order to engage a non-academic audience, the respondents indicated that policy-makers, industry, and the wider public must have access to the original research, both the underlying data and the conclusions. In this regard, greater support for open research, such as greater provision of open access publication models across all key stakeholders, could be an important step to take to allow non-academic readers to access and engage with the latest research.

To help realise the potential reach, impact, and policy application of the latest original research, respondents noted that research outcomes should be presented in a format, style, and language that is accessible and comprehensible to a non-academic audience32, or to pursue tailored research syntheses for a particular point of use, although such syntheses have been found to have varied impacts on policy and practice19. Whilst the research article well-serves the research community, the structure, length, and tone may create some barriers for non-academic readers, who are often looking for evidence pertaining to their particular point of need and may be put-off from drawing out points of relevance from a full research paper.

Finally, respondents indicated that authors and publishers should seek to maximize the opportunity to bring the latest research into the public conscious, with the aim of cultivating a culture that drives policy change by engaging with live policy issues. It was suggested that this could be achieved by adopting a transdisciplinary approach at the outset of a piece of work, involving scientific and societal stakeholders32. Respondents noted that non-academic summaries, workshops, and discussion forums could directly engage with policy-makers right at the point of need. However, as noted by one respondent, it is important for publishers to “be present” where appropriate at policy events and to advocate for the value of the research that they publish on behalf of their authors. Such value, which increasingly extends to public and policy engagement must also be recognised and valued by institutions and funders with respect to career advancement and reputational growth31,34.

Conclusion

Following a survey of >2,500 researchers who had published in our Earth & Environmental Sciences journals portfolio, we found that a majority of respondents (90%) indicated that their work either currently contributed to meeting real-world problems or that it would become a priority in the future, thus suggesting that, as one might anticipate, the tackling of real-world challenges is a significant research priority in the Earth & Environmental Sciences.

Whilst it is encouraging to see that the majority of research in the subject area is concerned (directly or indirectly) with addressing global needs, the impetus seems to be altruistic researcher desire, rather than incentives or support from publishers, funders, or institutions. As a result, it seems that this necessary application of original research is being lost
amidst the realities of being a researcher – where success is predominantly measured by citations and readership. Respondents suggested four key areas for action by publishers and other stakeholders across the scholarly communication ecosystem to help researchers meet their aspiration for their work to have real world impact: access, accessibility, communication of outcomes, and timeliness.

Data availability

Underlying data

Figshare: Taylor-and-Francis_Impact-Assessment-of-Earth-and-Environmental-Sciences-Research-Author-Survey_Raw-Data_Figshare, https://doi.org/10.6084/m9.figshare.13281146.v1\(^{19}\).

Extended data

Figshare: Taylor-and-Francis_Earth-and-Environment-Survey-Questions, https://doi.org/10.6084/m9.figshare.13281104.v1\(^{19}\).

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

This paper was written using data obtained on (DATE), from Digital Science’s Dimensions platform, available at https://app.dimensions.ai. Access was granted to subscription-only data sources and functions under licence agreement.

https://doi.org/10.6084/m9.figshare.20176412

References

1. Sugimoto CR, Allen L, Jeroen B, et al.: Rethinking impact factors: New pathways in journal metrics (version 1; not peer reviewed). F1000Res. 2019; 8: 677. Publisher Full Text

2. Herman E, Akeroyd J, Bequet G, et al.: The changed - and changing - Landscape of serials publishing: Review of the literature on emerging models. Leon Publ. 2020; 33(3): 213-229. Publisher Full Text

3. Sarewitz D, Pielke RA Jr. The neglected heart of science policy: reconciling supply of and demand for science. Environ Sci Policy. 2007; 10(1): 5-16. Publisher Full Text

4. Poppy G. Science Must Prepare for Impact. Nature. 2015; 526(7571): 7. PubMed Abstract | Publisher Full Text

5. Niles MT, Schimanski LA, McKiernan EC, et al.: Why we publish where we do: Faculty publishing values and their relationship to review, promotion and tenure expectations. PloS One. 2020; 15(3): e0228914. PubMed Abstract | Publisher Full Text | Free Full Text

6. Harley D, Acord SK, Earl-Novelli S, et al.: Assessing the future landscape of scholarly communication: An exploration of faculty values and needs in seven disciplines. Berkeley, CA: University of California Center for Studies in Higher Education, 2010; 2010. Reference Source

7. Taylor & Francis: Taylor & Francis researcher survey 2019. 2019. Reference Source

8. Rowley J, Johnsson F, Staffi L, et al.: Academics’ behaviors and attitudes towards open access publishing in scholarly journals. J Assoc Inf Sci Technol. 2017; 68(5): 1201–1211. Publisher Full Text

9. Alperin JP, Muñoz Nieves C, Schimanski LA, et al.: How significant are the public dimensions of faculty work in review, promotion and tenure documents? eWh. Edited by E. Pewsey et al. eLife Sciences Publications, Ltd, 2019; 8: e42254. PubMed Abstract | Publisher Full Text | Free Full Text

10. Springer Nature: Towards Societal Impact: Researcher Attitudes and Motivations. 2020. Reference Source

11. International Handbook on Responsible Innovation A Global Resource. (eds R.v. Schomberg and J. Hankins), Edward Elgar Publishing, Northampton, MA, 2019. Reference Source

12. Higher Education Funding Council of England: The Nature, Scale and Beneficiaries of Research Impact: An Initial Analysis of Research Excellence Framework (REF) 2014 Impact Case Studies. London: HEFCE. 2015. Reference Source

13. Australian Research Council: State of Australian University Research 2015-2016: Volume 1 ERA National Report. Canberra: Commonwealth of Australia. Reference Source

14. Berlemann M, Haucap J: Which Factors Drive the Decision to Opt out of Individual Research Rankings? An Empirical Study of Academic Resistance to Change. Res Policy. 2015; 44(5): 1108-115. Publisher Full Text

15. Nicholas D, Jamali HR, Herman E, et al.: A global questionnaire survey of the scholarly communication attitudes and behaviours of early career researchers. Learn Publ. 2020; 33(3): 198-211. Publisher Full Text

16. Lane J: Let’s make science metrics more scientific. Nature. 2010; 464(7288): 488-489. PubMed Abstract | Publisher Full Text

17. Solans-Domènech M, Pons JM, Adam P, et al.: Development and validation of a questionnaire to measure research impact. Res Eval. 2019; 28(3): 253–262. Publisher Full Text

18. Geosciences and the Sustainable Development Goals. (Eds Gill, J.C. and Smith, M.), Springer–Nature, Amsterdam. 2021. Publisher Full Text

19. Research & Analytics, Taylor & Francis: Taylor-and-Francis_Earth-and-
20. Molas-Gallart J, D’Este P, Llopis O, et al.: Towards an Alternative Framework for the Evaluation of Translational Research Initiatives. Research Evaluation. 2016; 25(3): 235–43. Publisher Full Text

21. Kok MO, Schuit AJ: Contribution mapping: a method for mapping the contribution of research to enhance its impact. Health Res Policy Syst. 2012; 10: 21. PubMed Abstract | Publisher Full Text | Free Full Text

22. Francis T, Kelly A, Agyeman J, et al.: Sustainable Development Goals in the Earth & Environmental Sciences. Publisher Full Text

23. International Science Council: Opening the record of science: making scholarly publishing work for science in the digital era. Paris, France. 2021. Reference Source

24. Digital Science: Dimensions. [Software]. 2018; Accessed on (DATE), under licence agreement. Reference Source

25. AI Ethics in Scholarly Communication. STM Association, 2021. Reference Source

26. Irawan DE, Abraham J, Tennant J, et al.: The Need for a New Set of Perspectives to Measure Research Impact in Earth Sciences: Indonesian’s Case. SocArXiv. 2020. Publisher Full Text

27. Fryirs KA, Brierley GJ, Dixon T: Engaging with research impact assessment for an environmental science case study. Nat Commun. 2019; 10(1): 4542. PubMed Abstract | Publisher Full Text | Free Full Text

28. Suggestions for a National Framework for Publication of and Access to Literature in Science and Technology in India. Appendix 3, point 1. Reference Source

29. Taylor & Francis Journals Author Survey. (results not publicly available).

30. Lunn J, Hanson B: Providing greater context for Earth and space science research. Eos. 2017; 98. Publisher Full Text

31. Wyborn C, Louder E, Harrison J, et al.: Understanding the Impacts of Research Synthesis. Environmental Science & Policy. 2018; 86: 72–84. Publisher Full Text

32. Brennan M, Rondón-Sulbarán J: Transdisciplinary research: Exploring impact, knowledge and quality in the early stages of a sustainable development project. World Development. 2019; 122: 481–491. Publisher Full Text

33. Hanson B, Pandya R, Stal S, et al.: Expanding recognition for contributions of science to society. Eos. 2018; 99. Publisher Full Text

34. Singh GG, Farjalla VF, Chen B, et al.: Researcher engagement in policy deemed societally beneficial yet unrewarded. Front Ecol Environ. 2019; 17(7): 375–382. PubMed Abstract | Publisher Full Text | Free Full Text

35. Research & Analytics, Taylor & Francis: Taylor-and-Francis_Impact-Assessment-of-Earth-and-Environmental-Sciences-Research-Author-Survey_Raw-Data, Figshare. Dataset. 2020. http://www.doi.org/10.6084/m9.figshare.13281146.v2
Kathryn Oliver
Faculty of Public Health and Policy, London School of Hygiene and Tropical Medicine, London, UK

Thanks for a chance to read this paper, from an interesting mixed team. Apologies from me too that this has taken so long to deliver; I can see that the first revision has already produced lots of improvement.

Back in 2014 I undertook a systematic review of barriers and facilitators of evidence use in policy. Most of the 145 studies included were surveys of academics by other academics, identifying factors which they felt affected whether or not their research had impact.

I mention this because as far as we could tell, these surveys were nearly all based on researchers' opinions, which could not be verified from observational, ethnographic or experimental studies of evidence use in policy. This doesn't imply that researchers are providing misleading answers, but there is a well-documented comprehension gap in academic generally about how policy works and how research impact actually occurs.

You deal with this a bit in the ambitions vs. reality section, where you contrast the stated desire of researchers to undertake applied research with their preference for citations. You could discuss this a bit more by explaining what you (and if possible they) mean by 'real world application' and the other categories. I suspect most researchers think that their work does in some way 'tackle' a real world problem - the question is at how many degrees removal is that the case. Overall I would urge caution in how interpretations of this finding is worded, e.g. researchers “indicated that they BELIEVED their work either currently contributed to meeting real-world problems or that it would become a priority in the future”, and “Whilst it is encouraging to see that RESEARCHERS FEEL THAT the majority of research in the subject area is concerned (directly or indirectly) with addressing global needs” etc.

For me the most interesting bit is about the role of journals and publishers. There is some connection here to the history of learned societies, who as you know were the first publishers of regular academic communications. The suggestions raised by your respondents are all very instrumental (e.g. formatting etc) but I wonder if you would like to comment on the role of
journals in promoting relationships and community, in raising the quality of research (through forging those links) and maintaining standards (which of course could include utility of research as a quality marker).

Some of the other suggestions raised by respondents (e.g. more academic-policy engagement) relate to an evidence base which is actually pretty weak. Some of the data we collected in this project looked at publisher- and journal-led activities to promote research impact, although we didn't find many examples. Happy to share our data on this if helpful - I think there were a couple of prizes offered by publishers (e.g. Emerald) and some convening.

References
1. Oliver K, Innvar S, Lorenc T, Woodman J, et al.: A systematic review of barriers to and facilitators of the use of evidence by policymakers. *BMC Health Serv Res*. 2014; 14: 2 PubMed Abstract | Publisher Full Text
2. Late E, Korkeamäki L, Pölönen J, Syrjämäki S: The role of learned societies in national scholarly publishing. *Learned Publishing*. 2020; 33 (1): 5-13 Publisher Full Text
3. Hopkins J: The role of learned societies in knowledge exchange and dissemination: the case of the Regional Studies Association, 1965–2005. *History of Education*. 2011; 40 (2): 255-271 Publisher Full Text
4. Oliver K, Hopkins A, Boaz A, Guillot-Wright S, et al.: What works to promote research-policy engagement?. *Evidence & Policy*. 2022. 1-23 Publisher Full Text

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Evidence production and use, research impact, academic-policy engagement

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
Thanks for a chance to read this paper, from an interesting mixed team. Apologies from me too that this has taken so long to deliver; I can see that the first revision has already produced lots of improvement.

We're grateful for you making the time to review our paper and for your comments.

Back in 2014 I undertook a systematic review of barriers and facilitators of evidence use in policy. Most of the 145 studies included were surveys of academics by other academics, identifying factors which they felt affected whether or not their research had impact. I mention this because as far as we could tell, these surveys were nearly all based on researchers’ opinions, which could not be verified from observational, ethnographic or experimental studies of evidence use in policy. This doesn't imply that researchers are providing misleading answers, but there is a well-documented comprehension gap in academic generally about how policy works and how research impact actually occurs.

You deal with this a bit in the ambitions vs. reality section, where you contrast the stated desire of researchers to undertake applied research with their preference for citations. You could discuss this a bit more by explaining what you (and if possible they) mean by ‘real world application’ and the other categories. I suspect most researchers think that their work does in some way ‘tackle’ a real world problem - the question is at how many degrees removal is that the case.

A similar point was raised by another reviewer, and we agree that we likely presumed too much understanding of this term by the respondents to the survey, which may have been exacerbated by our use of a series of terms interchangeably without definition. The 2014 article is well-noted, thank you for highlighting it. In the first revision, we added a section, Terms and terminology, to briefly define our understanding of these terms, and we have now added a comment that these terms may not have been commonly understood by all respondents to the survey, which may have then contributed to the gap between our authors’ feedback and the Dimensions analysis. We have also expanded this section to further articulate what we understand by these terms.

Overall I would urge caution in how interpretations of this finding is worded, e.g. researchers “indicated that they BELIEVED their work either currently contributed to meeting real-world problems or that it would become a priority in the future”, and “Whilst it is encouraging to see that RESEARCHERS FEEL THAT the majority of research in the subject area is concerned (directly or indirectly) with addressing global needs” etc.

Yes, this is a fair criticism. We have revised some of our terminology to be more dispassionate, rather than inferring the feelings/beliefs of our respondents.

For me the most interesting bit is about the role of journals and publishers. There is some connection here to the history of learned societies, who as you know were the first publishers of regular academic communications. The suggestions raised by your respondents are all very instrumental (e.g. formatting etc) but I wonder if you would like to comment on the role of journals in promoting relationships and community, in raising the quality of research (through
forging those links) and maintaining standards (which of course could include utility of research as a quality marker).

Our author survey also included questions relating to the extent to which the article influenced future career events for our authors (e.g., future collaboration, promotion, or invitation to join an Editorial Board/speak at a conference), and, as you mention, whether publication of their article led to the forming of new connections (both within the subject area and with non-academic communities, and domestically/internationally). We have omitted these results from this paper, as we felt that they related more to the wider value of publishing in academic journals, rather than the main topic of this paper, but would be happy to share the data with you and have expanded on this slightly.

Some of the other suggestions raised by respondents (e.g. more academic-policy engagement) relate to an evidence base which is actually pretty weak. Some of the data we collected in this project looked at publisher- and journal-led activities to promote research impact, although we didn't find many examples. Happy to share our data on this if helpful - I think there were a couple of prizes offered by publishers (e.g. Emerald) and some convening.

Thank you for sharing this paper. We have included a comment to note some caution about the effectiveness of such engagement activities. Yes please, we would be very interested in discussing your analysis and picking this discussion up separately as we look to develop future activities in this area.

Since this survey, we have been working on the topic of engagement and impact, with a focus on the research-policy exchange, and published a Policy Note with the UK Higher Education Policy Institute (HEPI) on this topic last year, which we'd be delighted to discuss with you in more detail (available here: https://www.hepi.ac.uk/wp-content/uploads/2022/12/Why-open-access-is-not-enough-Spreading-the-benefits-of-research-1.pdf). You may also find a recent report from HEPI of interest as well: ‘How to talk to policymakers about research’, based on interviews with those experienced in working in the policy and HE sectors: https://www.hepi.ac.uk/wp-content/uploads/2023/01/How-to-talk-to-policymakers-about-research.pdf.

**Competing Interests:** No competing interests were disclosed.
American Geophysical Union, Washington, USA

The authors have revised the paper extensively and seem to have at least considered all the original comments constructively. The paper is now "published".

My only comment is wrt ref. 29. Does F1000 allow references to "data not available?" This seems odd for a journal demonstrating otherwise complete transparency. I understand that the full author survey is not available, but it would seem that the authors/TF could at least extract these data if they want to cite it and provide basic statistics around it (N of respondents, etc.)

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Earth and space science broadly, and scholarly publishing

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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Author Response 28 Feb 2023

**Andrew Kelly**

We have prepared a summary sheet of the data for this question, which has been hosted on FigShare, and updated the reference. Thank you for raising this issue.

**Competing Interests:** No competing interests were disclosed.
I am having some difficulties with the policy framing of the article, and it does not become obvious what point exactly the authors intend to make. A few statements don't appear to match up.

The article touches on many topics, but I feel that none of them are discussed to a sufficient extent. It initially centres around 3 key questions that are to be addressed by a survey of authors, but towards the end it morphs into an essay on developing an environment that supports translating research into policy, which is not much underpinned by the survey data. Consequently, the article feels like two that are loosely connected. Moreover, it sometimes reads like a policy statement and advertisement by Taylor & Francis rather than a research article. This impression is strengthened by the lack of research articles amongst the references in conjunction with the authors not adequately positioning their findings in the context of other research on the topic.

There is a fundamental conflict between the aspiration of “maximising the capability of research to achieve” and focusing efforts on addressing urgent needs, which remains unresolved in the article. Throughout, these are conflated and confused. I would consider “capability” a most relevant keyword in this context.

Several references are ill-chosen for supporting the specific point that the authors try to make. Specifically, the Lisbon strategy (reference 1) has the declared aim “to make Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”, but it does not include an explicit call for research to have “impact”. Moreover, the report of reference 21 states that “People are broadly split on whether the UK invests too much in long-term R&D rather than solving issues that matter now (33% agree vs. 35% disagree)”. The link in reference 20 does not work.

It is rather unusual for me to defend Michael Gove, but “we no longer need experts” is a (popular) misquotation by omission. He stated: “I think the people of this country have had enough of experts with organisations with acronyms saying that they know what is best and getting it consistently wrong.”, and the latter part of the statement is much relevant for scientists engaging in public debate. It is important to know how to build and maintain trust.

While the authors elaborate on the term “impact”, it remains problematic and likely to be
understood in various ways. One could challenge the statement about quantification in economic terms being straightforward, and in particular question whether benefits should be evaluated in such a way. For example, people dying early could be economically beneficial, but would that be societally desired?

The “missions” approach in Horizon Europe is somewhat controversial. Notably, the recent 2020 Euroscience Open Forum (ESOF) included a session “Does science for missions undermine the missions of science?”. Likewise, the authors state that the drive to solve “the Grand Challenges of our time” has acquired increased urgency during the COVID-19 pandemic, but one could also argue that prominently reveals a potential flaw of focusing on identified challenges, which is in neglecting those strands of research that are most suitable to provide the basis for the next challenges that we are to encounter (e.g. https://www.statnews.com/2020/02/10/fluctuating-funding-and-flagging-interest-hurt-coronavirus-research/ and https://www.nytimes.com/2021/04/08/health/coronavirus-mrna-kariko.html)

The authors refer to citations as the primary currency of success or progress, but it might be worth keeping in mind that it is a widespread myth that this applies universally. In particular, the quoted UK Research Excellence Framework (REF) is not based on citation counts. Moreover, there are significant differences between “impact” in the REF and “Pathways to impact” in the context of funding applications to UK Research Councils. Both are distinct from the “Pathways to Impact initiative” (reference 11). I appreciate the authors mentioning a “chain reaction” emerging from original research. Could one elaborate on what would determine the value of research?

With regard to the role of academic publishing, I note that the International Science Council has recently published an insightful report “Opening the record of science: making scholarly publishing work for science in the digital era.”

The definition of the three main aims of the survey does not specify what group of people “our communities” refers to. I am far less confident than the authors about the respondents being “representative”. I would expect that those who just care about their bibliometric profile and other similar performance indicators are not inclined to spend any time responding, which would result in the respondents being more engaged for the scientific community and the wider society.

I found the “note about error bars and statistical significance” almost entirely stating trivialities, whereas the authors do not provide the crucial information of what the quoted “error bars” actually refer to and what they mean, which leave me unable to interpret them.

There are some substantial weaknesses with the survey questions and the provided answer options. It is somewhat confusing that in some cases respondents were able to pick any number of answers from a list, whereas in others the number of choices was limited. This poses some difficulties for the interpretation of the results and the limitations to answer options should be mentioned clearly in the respective figure and/or captions. It would also be useful if the authors referred to the question numbers.

My main concern with regard to the survey is about Q14 and Q16, which refer to “real-world problems”. I think that it is an unfortunate choice that the authors put these central rather than referring to Q11 in conjunction with Q3 on addressing the question on why researchers undertake the research that they do. While the term “real-world problem” carries a polemic tone suggesting
that academics might be detached from reality, “directly or indirectly contributing” is remarkably fuzzy. It is not clear to me what Q14 and Q16 are actually able to capture, and I feel that answering with “yes”, “no”, or “Don't know” is mostly a matter of interpretation of the question. I could make a case for my research falling into either of these categories, depending on what point of view I assume. In fact, “don't know” appears to be a good option given that for some research the connection to “real-word problems” is not immediately apparent and the connection might only be built in the future. Apparently, a substantial number of respondents chose that option. I also note that Q16 refers to “priority” whereas Q14 does not. I did not see the authors commented on lower numbers for an affirmative response on Q16 as compared to Q14.

I also wonder how many of the respondents are familiar with what the UN SDGs are, or are willing to look at up before they answer the question. I note that SDG 8 explicitly recognises creativity and innovation as drivers of economic growth, which aligns fundamental research, not directly targeted at specific challenges, with the UN SDGs.

Something that puzzles me is that 38% of the respondents did not choose the answer “I find researching these topics interesting”. Why do they do research that they are not interested in?

It would seem to me that the survey reveals another “gap” than the one the authors claim. A key gap appears to be in how the research actually materialises into something useful, with only about 20% of the survey respondents stated that “input into policy decision-making” or “contribution to tackling big real-world problems, such as those expressed by the UN SDGs” was amongst the most important forms of “impact” (although they were limited to 3 answers). In contrast, the authors elaborate on the point that respondents ranked formal recognition over making a contribution and state that we risk devaluing the necessary application of original research to addressing our global challenges by prioritising other metrics and outcomes. However, their study does not provide evidence for that. If the research of the respondents is oriented towards “real-world problems”, the underlying motivation is not the relevant issue. Unfortunately, the authors do not elaborate on to what extent “contribution to the advancement of research” is aligned with “contribution to tackling real-world problems” and/or “input into policy decision-making” or rather not. It is the more unfortunate that respondents were restricted to a maximum of 3 answers for Q11 rather than being able to state where each of them ranks in priority.

On the question of why authors chose to submit their manuscript to the specific journal, the top chosen answer is pretty much an umbrella category that encompasses more than half of the other answer options, which are more specific on what most “relevant” means.

The authors should define what they consider “Europe”, e.g. if respondents stated that they are located in Turkey, have their answers been included or not? To my knowledge, the UK is in Europe.

The mentioned effort on narrowing the science-policy gap is laudable, but can we expect getting the researchers onboard?

The authors mention “traditional” mechanisms around engagement, knowledge transfer, and research assessment, but in particular with respect to the latter, there are only fashions, but no tradition. A tradition only gets established once something is passed on from generation to generation, while we saw substantial changes on shorter time-scales. Notably, the h-index was not invented before 2005.
The authors argue that universities are well-positioned to “educate” their faculties, but are we facing a question of education? If researchers are motivated, aren’t they in need of support rather than incentives?

Channels to reach policy makers is certainly a relevant point, but looking at social media and news services, the question of quality pops up. Scientists with a large public followership are not necessarily the best suited to speak on a specific topic.

References
1. International Science Council: Opening the record of science: making scholarly publishing work for science in the digital era. International Science Council. 2021. Publisher Full Text

Is the work clearly and accurately presented and does it cite the current literature?
No

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
No

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Astronomy, science policy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 30 Jun 2022
Andrew Kelly

Responses have been added in-line below the reviewer’s comments and are shown in italics.

Reviewer’s comments:
I am having some difficulties with the policy framing of the article, and it does not become
obvious what point exactly the authors intend to make. A few statements don’t appear to match up.

The article touches on many topics, but I feel that none of them are discussed to a sufficient extent. It initially centres around 3 key questions that are to be addressed by a survey of authors, but towards the end it morphs into an essay on developing an environment that supports translating research into policy, which is not much underpinned by the survey data. Consequently, the article feels like two that are loosely connected. Moreover, it sometimes reads like a policy statement and advertisement by Taylor & Francis rather than a research article. This impression is strengthened by the lack of research articles amongst the references in conjunction with the authors not adequately positioning their findings in the context of other research on the topic.

We agree that the article needed to be more focused and has been reframed around the results of the author survey, rather than the non-citation value of academic research. The policy framing has been removed.

There is a fundamental conflict between the aspiration of “maximising the capability of research to achieve” and focusing efforts on addressing urgent needs, which remains unresolved in the article. Throughout, these are conflated and confused. I would consider “capability” a most relevant keyword in this context.

Several references are ill-chosen for supporting the specific point that the authors try to make. Specifically, the Lisbon strategy (reference 1) has the declared aim “to make Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”, but it does not include an explicit call for research to have “impact”. Moreover, the report of reference 21 states that “People are broadly split on whether the UK invests too much in long-term R&D rather than solving issues that matter now (33% agree vs. 35% disagree)”. The link in reference 20 does not work.

It is rather unusual for me to defend Michael Gove, but “we no longer need experts” is a (popular) misquotation by omission. He stated: “I think the people of this country have had enough of experts with organisations with acronyms saying that they know what is best and getting it consistently wrong.”, and the latter part of the statement is much relevant for scientists engaging in public debate. It is important to know how to build and maintain trust.

Yes, this section was initially reframed to focus on the increased public trust in science/research during the pandemic, but has now been removed owing to the tighter focus and the references have been updated.

While the authors elaborate on the term “impact”, it remains problematic and likely to be understood in various ways. One could challenge the statement about quantification in economic terms being straightforward, and in particular question whether benefits should be evaluated in such a way. For example, people dying early could be economically beneficial, but would that be societally desired?
We agree that the difficulty in qualifying impact itself is part of the challenge, whilst quantification isn't necessarily a good thing. We have reframed around the mobilisation/transfer of knowledge.

The “missions” approach in Horizon Europe is somewhat controversial. Notably, the recent 2020 Euroscience Open Forum (ESOF) included a session “Does science for missions undermine the missions of science?”. Likewise, the authors state that the drive to solve "the Grand Challenges of our time" has acquired increased urgency during the COVID-19 pandemic, but one could also argue that prominently reveals a potential flaw of focusing on identified challenges, which is in neglecting those strands of research that are most suitable to provide the basis for the next challenges that we are to encounter (e.g. https://www.statnews.com/2020/02/10/fluctuatingfunding-and-flagging-interest-hurt-coronavirus-research/ and https://www.nytimes.com/2021/04/08/health/coronavirus-mrna-kariko.html)

Yes, we agree, although the missions concept is gaining traction worldwide, potentially at the expense of curiosity-driven research. The discursive elements around Horizon Europe has been removed as part of the tightening of the article.

The authors refer to citations as the primary currency of success or progress, but it might be worth keeping in mind that it is a widespread myth that this applies universally. In particular, the quoted UK Research Excellence Framework (REF) is not based on citation counts. Moreover, there are significant differences between “impact” in the REF and “Pathways to impact” in the context of funding applications to UK Research Councils. Both are distinct from the “Pathways to Impact initiative” (reference 11). I appreciate the authors mentioning a “chain reaction” emerging from original research. Could one elaborate on what would determine the value of research?

With regard to the role of academic publishing, I note that the International Science Council has recently published an insightful report “Opening the record of science: making scholarly publishing work for science in the digital era.”

Thank you for sharing the reference. Our experience suggests that this is the case, along with other examples, such as Horizon Europe's business case, which comments on increased citations comparatively, but this has been modified or removed in the Introduction.

The definition of the three main aims of the survey does not specify what group of people “our communities” refers to. I am far less confident than the authors about the respondents being “representative”. I would expect that those who just care about their bibliometric profile and other similar performance indicators are not inclined to spend any time responding, which would result in the respondents being more engaged for the scientific community and the wider society.

We also agree that survey sampling tends to lead to some degree of self-selection, which may emphasise some biases. However, we were satisfied that the total number of responses across a wide range of journals and the geographical alignment of the respondents with the journals’
author base allowed us to have reasonable confidence in the representative nature of the results.

I found the “note about error bars and statistical significance” almost entirely stating trivialities, whereas the authors do not provide the crucial information of what the quoted “error bars” actually refer to and what they mean, which leave me unable to interpret them.

The error bars plot the confidence intervals for the percentages shown. If the error bars for two or more countries overlap, we have been cautious about making any substantive conclusions, because they may not be statistically significant, and only clearly statistically significant differences are discussed in our comparisons.

There are some substantial weaknesses with the survey questions and the provided answer options. It is somewhat confusing that in some cases respondents were able to pick any number of answers from a list, whereas in others the number of choices was limited. This poses some difficulties for the interpretation of the results and the limitations to answer options should be mentioned clearly in the respective figure and/or captions. It would also be useful if the authors referred to the question numbers.

The format of the question was selected according to the purpose of the question and the number of perceived answers. The phrasing of the questions was appropriate for the settings that were used; that is, the questions that presented a limited number of options used wording that emphasised priority, whereas the questions that allowed for an unlimited number of selections used wording that emphasised relevancy.

With regards the question that allowed a maximum of three responses, this was labelled clearly within the paper. within the text and chart labels.

My main concern with regard to the survey is about Q14 and Q16, which refer to “real-world problems”. I think that it is an unfortunate choice that the authors put these central rather than referring to Q11 in conjunction with Q3 on addressing the question on why researchers undertake the research that they do. While the term “real-world problem” carries a polemic tone suggesting that academics might be detached from reality, “directly or indirectly contributing” is remarkably fuzzy. It is not clear to me what Q14 and Q16 are actually able to capture, and I feel that answering with “yes”, “no”, or “Don’t know” is mostly a matter of interpretation of the question. I could make a case for my research falling into either of these categories, depending on what point of view I assume. In fact, “don’t know” appears to be a good option given that for some research the connection to “real-word problems” is not immediately apparent and the connection might only be built in the future. Apparently, a substantial number of respondents chose that option. I also note that Q16 refers to “priority” whereas Q14 does not. I did not see the authors commented on lower numbers for an affirmative response on Q16 as compared to Q14.

We used the phrase “real-world problems” as we felt it was commonly used parlance in aggregating topics such as the SDGs, but agree that there is some subjectivity there and there is a need for education of researchers in contextualising their work. We have included a brief section to introduce the terms below the note on error bars.
I also wonder how many of the respondents are familiar with what the UN SDGs are, or are willing to look at up before they answer the question. I note that SDG 8 explicitly recognises creativity and innovation as drivers of economic growth, which aligns fundamental research, not directly targeted at specific challenges, with the UN SDGs.

Whilst we did not probe the degree of familiarity of the respondents with the UN SDGs, or the scope of individual Goals or Targets, we believe that, especially in the subject areas covered by the survey, it is reasonable to assume that most respondents are broadly familiar with the priorities of the SDGs and that respondents who felt they were not sufficiently familiar with the SDGs to answer the question would have answered “don't know”.

Something that puzzles me is that 38% of the respondents did not choose the answer “I find researching these topics interesting”. Why do they do research that they are not interested in?

It would seem to me that the survey reveals another “gap” than the one the authors claim. A key gap appears to be in how the research actually materialises into something useful, with only about 20% of the survey respondents stated that “input into policy decision-making” or “contribution to tackling big real-world problems, such as those expressed by the UN SDGs” was amongst the most important forms of “impact” (although they were limited to 3 answers).

Thank you for sharing this observation, which has been included in the revision.

In contrast, the authors elaborate on the point that respondents ranked formal recognition over making a contribution and state that we risk devaluing the necessary application of original research to addressing our global challenges by prioritising other metrics and outcomes. However, their study does not provide evidence for that. If the research of the respondents is oriented towards “real-world problems”, the underlying motivation is not the relevant issue. Unfortunately, the authors do not elaborate on to what extent “contribution to the advancement of research” is aligned with “contribution to tackling real-world problems” and/or “input into policy decision-making” or rather not. It is the more unfortunate that respondents were restricted to a maximum of 3 answers for Q11 rather than being able to state where each of them ranks in priority.

We have added a new Venn diagram (Figure 5), which looks at the overlap of responses to three of the key options from question 11. The percentages are based on the total number of respondents selecting at least one of these three options. We chose to limit the number of responses to Q11 because we felt that, whilst it would have been worthwhile asking respondents to rank all of the answers, it would have been a much-larger undertaking to ask respondents to rank or rate nine answers. Additionally, asking respondents to rank all of the answers would not have allowed them to rank things as equally important/unimportant, or to leave some items unranked.

On the question of why authors chose to submit their manuscript to the specific journal, the top chosen answer is pretty much an umbrella category that encompasses more than half of the other answer options, which are more specific on what most “relevant” means.
The authors should define what they consider “Europe”, e.g. if respondents stated that they are located in Turkey, have their answers been included or not? To my knowledge, the UK is in Europe. The mentioned effort on narrowing the science-policy gap is laudable, but can we expect getting the researchers onboard?

A mapped list of countries to the regions that were used in the analysis has been added to the FigShare deposit.

The authors mention “traditional” mechanisms around engagement, knowledge transfer, and research assessment, but in particular with respect to the latter, there are only fashions, but no tradition. A tradition only gets established once something is passed on from generation to generation, while we saw substantial changes on shorter time-scales. Notably, the h-index was not invented before 2005.

The authors argue that universities are well-positioned to “educate” their faculties, but are we facing a question of education? If researchers are motivated, aren't they in need of support rather than incentives?

Channels to reach policy makers is certainly a relevant point, but looking at social media and news services, the question of quality pops up. Scientists with a large public followership are not necessarily the best suited to speak on a specific topic.

**Competing Interests:** No competing interests were disclosed.
Major points:

1) The main improvement needed for this paper is placing it in context of other work and author surveys. There are many related and similar surveys and analyses, done by publishers, societies, funders, and scholars, and none (not exaggerating; none) are cited or mentioned. Much of the findings here regarding citations and priorities around publishing, open access, and more, have been covered in other recent author surveys, in this general discipline and other disciplines. This context is essential for this paper to be considered scholarly (and published in a scholarly journal). I've reviewed a lot of papers over the years, and this is the first submitted to a leading journal where I've seen such a lack of referencing. This might be acceptable for a report by a publisher (cf. Elsevier's recent gender analysis, self-published, also completely without references) but not a submission to a scholarly journal. Most of the references are just to websites, not any formal survey results or scholarly research on these topics (there's a lot even in the past few years). Such comparisons would also strengthen some of the conclusions.

Just a note that JpGU and AGU have conducted a somewhat similar survey of their members. The results are not published yet but were presented in this session: https://agu.confex.com/agu/fm20/meetingapp.cgi/Session/105702 at the recent AGU Fall Meeting (see presentation starting at about 40 minutes; registration is required). I've been involved in helping this survey. Overall these results (and others AGU has conducted but not published) are similar to the results given in the later questions here regarding selecting journals, citations, etc. However, on the motivation for research (first question in this survey, and the one that sets that main stage for discussion), the AGU-JpGU wording was different but a large number of respondents, well beyond a majority, indicated that their primary motivation for research was around basic “discovery” or “elaboration/synthesis” rather than “responding to responsibility of society.” JpGU members even moreso. In this survey, unlike the T&F one, there was a large age-related difference between early career, and later-career respondents (early career researchers were more focused on topics related to societal impact). I suspect that the populations of respondents overlap heavily in the two surveys. Recognizing that the AGU-JpGU results are not yet fully analyzed or published, I'm just raising this to bring caution to over interpreting the first question of this survey as worded. This question is, however, the most interesting one to explore and provides much of the interesting novelty here. Just be cautious in interpreting the answers.

One test would be also to simply score recent publications (outputs) as to whether they align with the results—that is, do most of the outputs directly or indirectly support SDGs, for example? My sense is that in the Earth and space sciences, many indirectly do, but that the path is long and I'm not sure 75% would without quite a stretch.

2) As the authors note there is a disconnect between authors reporting that they are working (directly or indirectly) on societal relevant topics vs. the “impact” (that is, citations) that they are seeking in their work. Further exploration is needed on whether the respondents misinterpreted the first question or if it was worded so vaguely (“indirectly”) as to be meaningless. Note that much “basic” research in the Earth, environmental, and space science has widespread indirect impacts. Much real time “basic-science” data about the Earth is used in the GPS system, weather predictions, or other uses, e.g. For examples, see this discussion here that I was involved with: https://eos.org/editors-vox/earth-and-space-science-for-the-benefit-of-humanity and the linked papers. Indeed many grant applications require a statement regarding impacts.
Similarly, results for the question on impact expected by the authors are used in comparison. I also wonder if the wording and reality of the scope of published papers drove this response (that is, many have an indirect vs. direct impact) and the response was viewed as a direct impact.

3) The authors list a number of actions T&F are taking or should take. Interestingly, T&F has not signed DORA—as Springer-Nature and Elsevier have now signed (whatever one thinks of that), Wiley and T&F are the major publishers who have not (many individual society journals published with Wiley have). Perhaps the authors could indicate why or why not that would be appropriate and how to leverage that impact. Here's a recent editorial from a T&F publication: https://www.tandfonline.com/doi/full/10.1080/10919392.2018.1522774

4) The authors indicate what some stakeholders, especially publishers, might do. In the Earth environment and space sciences, there are several leading global societies. These are not mentioned. What is their role? Many have missions aligned with providing benefits to society and many are involved in science communication, policy, outreach and training/mentoring (more so than most commercial publishers and indeed universities). Indeed this might be an argument to focus on publishing with a society versus a commercial title, where these resources are more directly leveraged.

Other items:

The authors argue that it is surprising that JIF is important to researchers but that they don't always/regularly choose the highest JIF journals when submitting. This is because researchers know rejection rates and do optimization around likelihood of success (or they don't want to waste their time, which is also important).

**Is the work clearly and accurately presented and does it cite the current literature?**
No

**Is the study design appropriate and is the work technically sound?**
Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Partly

**Competing Interests:** As stated in the review, I'm working on a similar survey (advising) that is completed but not yet published.
Reviewer Expertise: Earth and space science broadly, and scholarly publishing

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 01 Jul 2022

Andrew Kelly

Responses to the reviewer comments have been added in italics.

Reviewer’s comments:
This is a report of an interesting survey getting at a major question related to understanding motivations of researchers in conducting and publishing research, and ultimately how to align incentives to support, recognize, and reward better research and activities of scholars aimed at addressing societal challenges and working with communities.

Major points:
1) The main improvement needed for this paper is placing it in context of other work and author surveys. There are many related and similar surveys and analyses, done by publishers, societies, funders, and scholars, and none (not exaggerating; none) are cited or mentioned. Much of the findings here regarding citations and priorities around publishing, open access, and more, have been covered in other recent author surveys, in this general discipline and other disciplines. This context is essential for this paper to be considered scholarly (and published in a scholarly journal).

I've reviewed a lot of papers over the years, and this is the first submitted to a leading journal where I've seen such a lack of referencing. This might be acceptable for a report by a publisher (cf. Elsevier's recent gender analysis, self-published, also completely without references) but not a submission to a scholarly journal. Most of the references are just to websites, not any formal survey results or scholarly research on these topics (there's a lot even in the past few years). Such comparisons would also strengthen some of the conclusions.

Just a note that JpGU and AGU have conducted a somewhat similar survey of their members. The results are not published yet but were presented in this session: https://agu.confex.com/agu/fm20/meetingapp.cgi/Session/105702 at the recent AGU Fall Meeting (see presentation starting at about 40 minutes; registration is required). I've been involved in helping this survey.

Thank you and we acknowledge the limitations of our introduction. As part of the refocusing of the article, we have pared-back the introduction to the article and included additional referencing to support the discussion.

Overall these results (and others AGU has conducted but not published) are similar to the
results given in the later questions here regarding selecting journals, citations, etc. However, on the motivation for research (first question in this survey, and the one that sets that main stage for discussion), the AGU-JpGU wording was different but a large number of respondents, well beyond a majority, indicated that their primary motivation for research was around basic “discovery” or “elaboration/synthesis” rather than “responding to responsibility of society.” JpGU members even more so. In this survey, unlike the T&F one, there was a large age related difference between early career, and later-career respondents (early career researchers were more focused on topics related to societal impact). I suspect that the populations of respondents overlap heavily in the two surveys. Recognizing that the AGU-JpGU results are not yet fully analyzed or published, I'm just raising this to bring caution to over interpreting the first question of this survey as worded. This question is, however, the most interesting one to explore and provides much of the interesting novelty here. Just be cautious in interpreting the answers.

Thank you for raising this and we agree that it would be interesting to investigate further.

One test would be also to simply score recent publications (outputs) as to whether they align with the results—that is, do most of the outputs directly or indirectly support SDGs, for example? My sense is that in the Earth and space sciences, many indirectly do, but that the path is long and I'm not sure 75% would without quite a stretch.

This was a very interesting suggestion. We have used Dimensions SDGs category data (new Figure 2) to analyse their quantitative alignment of research published in the same set of journals with the SDGs and compared this with the author’s qualitative responses.

2) As the authors note there is a disconnect between authors reporting that they are working (directly or indirectly) on societal relevant topics vs. the “impact” (that is, citations) that they are seeking in their work. Further exploration is needed on whether the respondents misinterpreted the first question or if it was worded so vaguely (“indirectly”) as to be meaningless. Note that much “basic” research in the Earth, environmental, and space science has widespread indirect impacts.

Much real time “basic-science” data about the Earth is used in the GPS system, weather predictions, or other uses, e.g. For examples, see this discussion here that I was involved with: https://eos.org/editors-vox/earth-and-space-science-for-the-benefit-of-humanity and the linked papers. Indeed many grant applications require a statement regarding impacts. Similarly, results for the question on impact expected by the authors are used in comparison. I also wonder if the wording and reality of the scope of published papers drove this response (that is, many have an indirect vs. direct impact) and the response was viewed as a direct impact.

A comment has been added on this in the revised submission to note further research would be useful to better understand the motivations and responses.

3) The authors list a number of actions T&F are taking or should take. Interestingly, T&F has not signed DORA—as Springer-Nature and Elsevier have now signed (whatever one thinks
of that), Wiley and T&F are the major publishers who have not (many individual society journals published with Wiley have). Perhaps the authors could indicate why or why not that would be appropriate and how to leverage that impact. Here’s a recent editorial from a T&F publication: https://www.tandfonline.com/doi/full/10.1080/10919392.2018.1522774

Pleasingly, Taylor & Francis has since signed DORA, but no comment has been made in the article, as the policy-related points have been removed.

4) The authors indicate what some stakeholders, especially publishers, might do. In the Earth environment and space sciences, there are several leading global societies. These are not mentioned. What is their role? Many have missions aligned with providing benefits to society and many are involved in science communication, policy, outreach and training/mentoring (more so than most commercial publishers and indeed universities). Indeed this might be an argument to focus on publishing with a society versus a commercial title, where these resources are more directly leveraged.

This was an oversight from the previous submission. As we have removed the policy discussion, we haven’t elaborated on this further, but we acknowledge the mission focus of many of the leading societies and their importance in shaping the behaviours of researchers in their communities.

Other items:
The authors argue that it is surprising that JIF is important to researchers but that they don’t always/regularly choose the highest JIF journals when submitting. This is because researchers know rejection rates and do optimization around likelihood of success (or they don’t want to waste their time, which is also important).

We agree that likelihood of success is one of the main drivers in the decision-making of authors when selecting a journal and included a paragraph on whether the article was finally published in the first/second/third-or-more choice. We also suggest that speed of publication/time to first decision, and the journal’s relevance to the community are other important drivers in addition to acceptance rate and Impact Factor.

Competing Interests: No competing interests were disclosed.
**Competing Interests:** No competing interests were disclosed.

Author Response 14 Jun 2021

Andrew Kelly

Dear reviewers,

Thank you for your careful and thorough reviews. We have been working through the comments and plan to submit a revised version in due course.

One of the major points of concern, which you both raised, was that the paper appeared in some aspects closer to a report/white paper than a research article, in particular in terms of the literature review and the discussion around the uptake of research into policy decision-making. We found these comments especially useful and have been discussing how best to tackle them.

After discussion with the editorial team, we propose to remove the discussion section and the policy-related introductory paragraphs into a separate non-peer-reviewed piece, where they may be better suited. We plan to re-focus as a much-shorter communication of the results of the survey, as the main source of novelty within the work. We would make that clear in a revised title and abstract; a briefer introduction, which would have a narrower scope to review other similarly positioned surveys; and an abbreviated conclusion. We will also address the other comments with respect to the survey and analysis.

Before substantially revising the article in this way, we would like to take the opportunity afforded by the open-peer-review process to ask what you thought of this approach. We would appreciate your comments and thank you again for your feedback to date.

**Competing Interests:** None
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