Awareness of and engagement with Open Research behaviours: Development of the Brief Open Research Survey (BORS) with the UK Reproducibility Network

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Abstract

Objectives: A need for Open Research practices exists, yet there remains a lack of validated questionnaires to assess Open Research practices. The study aimed to develop a brief (<5 minutes), standardised questionnaire to measure Open Research awareness and engagement across UK institutions.

Methods: The Brief Open Research Survey (BORS) was developed in six steps: 1) a scoping exercise collated previous questionnaires on Open Research, 2) a brief questionnaire was developed, 3) peer-reviewed, 4) piloted, 5) revised, and 6) the final questionnaire was distributed across UK Reproducibility Network (UKRN) local networks.

Results: Respondents across thirty-five UKRN local networks participated (n = 1,274). Respondents were most aware of Open Access publications (94.1%) and also used them the most (76.5%). They were least aware of Registered Reports (38.1%) and also used them the least (8.3%). Respondents reported that incentives (51%), dedicated funding (46.2%), and recognition in promotion and recruitment criteria (39.6%) would help them embed Open Research.

Conclusion: Although various Open Research initiatives exist, there remains a disconnect between awareness and implementation. Support from funders and institutions is required to increase Open Research. The Brief Open Research Survey can be used to track uptake over time and adapted to measure Open Research globally.

Keywords: open research, meta research; transparency; UK Reproducibility Network; responsible research practices

Background:

Open Research, also referred to as Open Science or Open Scholarship, is an umbrella term reflecting that knowledge should be open, transparent, rigorous, reproducible, replicable, cumulative, and inclusive (Parsons et al., 2022). It encompasses practices, or behaviours, that can be embedded across the entire research process from conceptualisation to dissemination for the purposes of improving research quality Prior to data collection, preregistration of public, time-stamped planned methods and analyses to an online repository attempts to limit analytical flexibility in confirmatory research (Henderson, 2022; Simmons et al., 2021). Registered Reports allow provisional publication acceptance based on the quality of the study rationale and protocol, shifting the focus to rigorous study design rather than the nature of results (Chambers & Tzavella, 2022). After data collection, making study materials, analytical code, software and data publicly available facilitates research transparency, replication, and reuse (Fortunato & Galassi, 2021; Tenopir et al., 2020). At dissemination, article preprint servers (e.g., PsyArXiv, medRxiv, SocArXiv, AfricArXiv) allow readers early access to new research and authors to benefit from reader comments and to correct mistakes prior to and during pre-publication peer-review (Watson, 2022) and, along with Open Access publishing (Basson et al., 2021), aid the accessibility of research. A glossary of concepts related to Open Research has recently been published to consolidate a shared terminology in this area and to reduce communication barriers (Parsons et al., 2022).

Open Research has been increasingly discussed over the past decade and is essential for improving research practice and culture across disciplines and career-levels (see Allen & Mehler, 2019; Edwards & Roy, 2017; Munafò et al., 2022; Nosek et al., 2012). However, the subsequent uptake of Open Research practices has not been systematically measured. There is currently a lack of validated questionnaires to objectively gauge awareness and engagement with Open Research that can easily be quickly implemented (Galesic & Bosnjak, 2009) and track progression as research fields move forward. This study aimed to develop an openly available, brief (<5 minutes), and standardised questionnaire to measure and evaluate Open Research awareness and behaviours across disciplines in UK Higher Education institutions.

Efforts to increase Open Research

Initiatives exist and have been recommended globally to increase the uptake of Open Research behaviours (G7 Open Science Working Group, 2021; NASA Science, 2022; UNESCO, 2021). Educational

initiatives include embedding Open Research training into undergraduate and postgraduate teaching (Azevedo et al., 2022; Egan et al., 2020; Student Initiative for Open Science, 2022) and providing banks of educational resources to facilitate this (Pownall, Azevedo, et al., 2021). Incentive initiatives include journal badges issued to papers with Preregistration, Open Data and Open Materials (Kidwell et al., 2016; Rowhani-Farid & Barnett, 2018), awards for Open Research practice (Merrett et al., 2021), and funder partnerships for Registered Reports (Chambers & Tzavella, 2022; Clark et al., 2021). Staff hiring (Khan et al., 2022) and promotion criteria (Moher et al., 2018) that explicitly value Open Research practices, quality and 'slow science' (Frith, 2020) are also being increasingly adopted.

International guidance on best practices for Open Research have influenced national policies, such as the San Francisco Declaration of Research Assessment (DORA, 2022) and the European University Association Open Science Agenda 2025 (European Universities Association, 2022), as well as the Transparency and Openness Promotion (TOP) guidelines for journal procedures and policies to promote Open Research (Nosek et al., 2016). Large team science consortia are working to openly and collaboratively deliver large replication attempts globally (Klein et al., 2014; Klein et al., 2018; Open Science Collaboration, 2015) and address important and complex research questions (Button et al., 2020; Pennington et al., 2022).

Various networks have also been established to support and promote Open Research practices (Armeni et al., 2021). Grassroots communities such as the ReproducibiliTea journal club (Orben, 2019) and RIOT Science clubs (RIOT Science Club, 2022) aim to discuss key papers in the field of Open Research and meta research with key invited speakers, whilst discipline and sub-discipline-specific committees aim to increase Open Research uptake within defined research communities (Norris & Toomey, 2020). International bodies such as the Center for Open Science (COS) provide free infrastructure for Open Research, such as the Open Science Framework (OSF; Foster & Deardorff, 2017). A growing number of national-level networks seek to promote Open Research uptake across disciplines, such as the UK Reproducibility Network (UKRN; www.ukrn.org) and its international partners (see Rahal et al., 2021; Stewart et al., 2022; UK Reproducibility Network Steering Committee, 2021). The UKRN is a peer-led consortium that aims to ensure the UK remains a centre for world-leading research, connecting local researcher networks, university and research institute members with stakeholder organisations such as funders, publishers and policymakers (UK Reproducibility Network Steering Committee, 2021).

Measures of Open Research

Antecedents to Open Research behaviours, including associated barriers and enablers, have been investigated with a view to maximising uptake (Osborne & Norris, 2022; Robson et al., 2021; Zečević et al., 2021). Meta-research has identified the extent to which researchers engage with Open Research across different disciplines (Cashin et al., 2021; Christensen et al., 2019; Hardwicke et al., 2021; Norris et al., 2021, 2022; Wallach et al., 2018). There have also been various questionnaire measures developed to assess Open Research behaviours within countries (Baždarić et al., 2021; Pardo Martínez & Poveda, 2018), specific disciplines (Abele-Brehm et al., 2019; Bakker et al., 2022; Bowman et al., 2021; Houtkoop et al., 2018), institutions (University of Glasgow, 2021) or academic status groups (Toribio-Flórez et al., 2021). However, there is no openly available, brief and standardised questionnaire to assess awareness, uptake, and support of Open Research behaviours within and across institutions and countries. This study hence aimed to develop such a questionnaire and administer it across the UK Reproducibility Network to assess current Open Research behaviours in UK institutions.

Methods and Results:

We developed the twelve item Brief Open Research Survey (BORS; Supplementary File 2) through the following six steps.

Step 1. Scoping exercise of previous questionnaires on Open Research

To inform the development of our questionnaire, we collated existing questionnaires that assessed Open Research behaviours by: i) reviewing existing surveys available by searching the Open Science Framework https://osf.io/, ii) reviewing published literature on the prevalence of Open Research, and iii) engaging in personal correspondence with authors developing questionnaires for their own institutions in the UKRN and beyond. This scoping exercise was not intended to be an exhaustive, all-inclusive review of all existing questionnaires capturing Open Research awareness and practices but to provide insight into tools that could help ensure maximal breadth and depth of questions in the brief (<5 minute) questionnaire.

Fifteen relevant existing questionnaires assessing Open Research behaviours were identified. Ten of these questionnaires were institution-specific and five were being distributed within broader disciplines such as psychology (Abele-Brehm et al., 2019; Houtkoop et al., 2018; van den Akker et al., 2020) or

geographical areas (Center for Open Science, 2022; Digital Science et al., 2019). Commonly explored areas within these questionnaires were awareness, attitudes, behaviours and perceived barriers towards Open Research. The reported times to complete surveys ranged from 5 minutes (e.g., Cardiff Open Science Internal Survey 2017; University of the West of England Open Science Internal Survey) to 20 minutes (Digital Science et al., 2019). Citations do not exist for all identified questionnaires, however, all questionnaires have been made available via this study's Open Science Framework page with consent of the questionnaire authors (https://osf.io/m6qxf/).

Step 2. Development of brief questionnaire

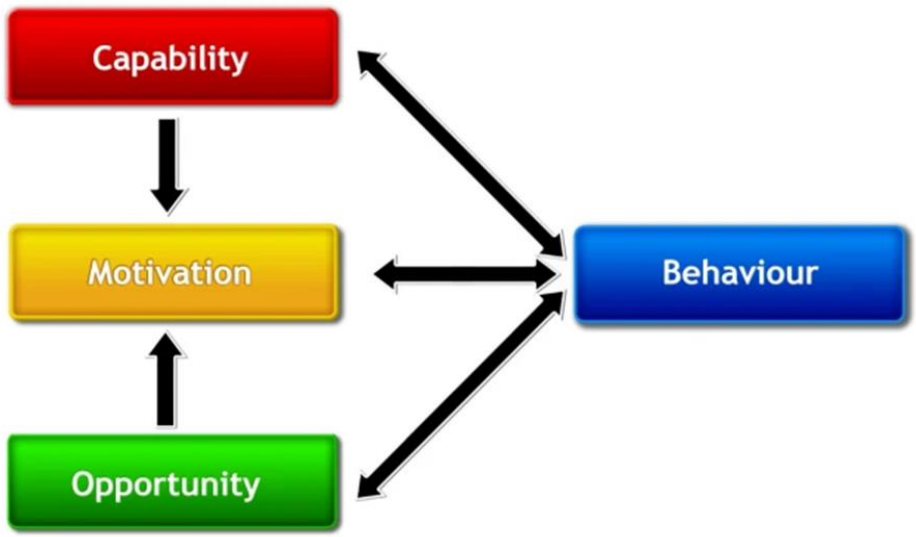
A brief (<5 minutes) questionnaire was drafted after reviewing existing relevant questionnaires to assess: i) self-reported awareness and use of Open Research behaviours, ii) support that would facilitate the uptake of Open Research, and iii) demographics of respondents.

First, two items assessed self-reported awareness and experience of using Open Research behaviours, including 'Open Research' as a general term, study Preregistration, Registered Reports, Open Materials, Open Data, Open Code, Preprints, Open peer review, Open Access publication, Replication studies and Research Co-production (11 options per item). Options for both awareness and experience questions were 'Yes', 'No' or 'Not applicable to my research'.

Second, one item assessed what support respondents perceived to be required to facilitate their use of more Open Research practices. The options for this specific item were developed according to the Capability Opportunity Motivation (COM-B) model of behaviour change (Michie et al., 2011). In short, the COM-B model of behaviour (see Figure 1) posits three essential conditions as required to result in behaviour: 'capability' (including psychological and physical capability) in the individual's psychological and physical capacity to enact a behaviour, 'opportunity' (including social and physical opportunity) in the physical and social environment beyond the individual that facilitates a behaviour, and 'motivation' (including reflective and automatic motivation) to perform the behaviour (see Michie et al., 2011; Norris & O'Connor, 2019). Option responses were structured according to the COM-B and included '*psychological capability'* (3 options): 'More information on Open Research practices', 'more training using Open Research practices' and 'understanding ethical issues (e.g., issues around data sharing)'; '*physical opportunity'* (4 options):' 'Supporting infrastructure (e.g., sufficient storage for Open Data),

'More time', 'Workload dedicated to Open Research' and 'Dedicated funding for Open Research'; '*social opportunity'* (4 options): 'Incentives from funders, institutions or other regulators', 'Recognition of Open Research in promotion and recruitment criteria', 'Support from senior researchers (e.g., supervisors and principal investigators) and 'Support from junior researchers (e.g., PhD students, early career researchers'; and '*Reflective motivation'* (2 options): 'Need for more positive beliefs about Open Research' and 'I do not plan to take up Open Research practices', alongside 'nothing' and 'additional' response options (15 options total). Respondents could select up to five options for this item.

Figure 1. The COM-B model of behaviour.



Note. From Michie et al. (2011): CC BY 2.0.

Third, six respondent demographic items were included to measure sample characteristics. This included College/Faculty/Division affiliations, academic discipline as assessed using HESA's Common Aggregation Hierarchy (CAH) Level 1 (Higher Education Statistics Agency, 2022), research methods used (4 options): 'Quantitative', 'Qualitative', 'Mixed' and 'Other', career level (7 options): 'Professor', 'Reader', 'Senior Lecturer', 'Lecturer', 'Senior Research Fellow', 'Research Fellow', ' Doctoral Researcher' (Doctoral Students) and 'Other', whether the participant was a member of their university's Open Research Working Group: Yes or No, and whether they were aware of the UK Reproducibility Network: Yes or No. A final free-text question optionally requested any additional comments.

Step 3. Peer-review of brief questionnaire

This draft questionnaire was reviewed by members of the UKRN steering group, three UKRN institutional leads and three UKRN Local Network Leads. No changes were suggested or made in this step. The original questionnaire used in the subsequent piloting stage is publicly available via https://osf.io/4q2fk/.

Step 4. Piloting of brief questionnaire

The questionnaire was piloted at Brunel University London, as it was a new local network member of UKRN, and its staff and doctoral students had not been previously surveyed on their range of Open Research behaviours. The online questionnaire was run on Qualtrics and made available for 4 weeks from April to May 2021. The questionnaire was sent out to all academic, research staff and doctoral students across all research disciplines via email and promoted through Brunel Staff Intranet, Research Support & Development Office, Graduate School, weekly COVID briefing webinars, and by senior staff and College research managers. Questionnaire results were discussed and recommendations established with consultation from the Brunel Open Research Working Group. Descriptive analyses were performed on the responses. Brief content analysis was performed on free-text responses provided, with comments provided verbatim. Staff response rates were calculated from data in the university's staff Human Resources system, and Doctoral student response rates were calculated from data in the university's student records system.

235 responses were received in this pilot study. Results are provided in Supplementary File 1; Tables 1-3. The dataset is provided at: https://osf.io/7ynxj/. The full report of this pilot data is provided on OSF: https://osf.io/453rd/.

Step 5. Revisions to questionnaire

The core research team (EN, CRP, KC and MM) identified aspects for improvement of the original questionnaire by reviewing: i) items receiving higher levels of missing data evident in the survey, ii) feedback provided within free-text comments in the survey, and iii) ensuring terminology, such as career-level titles, were appropriate beyond the pilot university for additional UK institutions. Firstly, the order of questions was revised to include institutional demographic questions at the start and to ensure responses were traceable to specific institutions. With regards to the latter, whilst we wanted to avoid

analyses being conducted on differences between institutions (to avoid a 'ranking system' of open science practices), we wanted to ensure that each institution was able to obtain their own data to use in strategy development. Second, some terminology was changed and expanded to ensure it was familiar to those in a UK context, with career titles revised from Doctoral Researcher to 'PhD Student' and Lecturer to 'Lecturer/Assistant Professor'. Third, Brunel-specific questions were removed, including a question requesting examples of Open Research practice to gather Brunel University-specific case studies, and a question requesting affiliation to Brunel-specific Colleges. The final twelve item questionnaire rolled out across UKRN institutions is shown in Supplementary File 2 and is freely available online: https://osf.io/57gm2/.

Step 6. Questionnaire distributed across UK Reproducibility Network (UKRN) institutions

The final online questionnaire was run on Qualtrics and made available for 18 weeks between September 2021 to January 2022. The questionnaire was distributed to UKRN Local Network institutions via their Local Network Leads who act as the institutional point of contact for UKRN and represent the grassroots network of researchers at that institution. Tips on how to promote the questionnaire at institutions were provided based on successful experiences in the piloting phase (Step 4), including seeking collaboration with Heads of Research, Faculty Managers, Heads of Department and University Internal Communications Team, as well as discussing the proposed dissemination plan within Open Research Working Groups. Local Network Leads were invited by the lead study authors to distribute the questionnaire at their institutions via email invites and Slack channels. Local Network Leads were advised that they would be provided with the data collected from their own institution after the study closed, to provide them with evidence on Open Research awareness, practices and required support within their community. They were also invited to be co-authors on this paper.

All academic staff, researchers and doctoral students were invited to respond, and they were informed that their responses would be anonymous. They were told that the study aim was to understand current awareness and use of Open Research, and that the data would be used to inform development of future Open Research-related training and support at their institution and across the UK Reproducibility Network.

Descriptive analyses were performed on responses at the overall sample level only. Institutional-level comparisons were not made to prevent judgements on the success of individual institutions' Open

Research initiatives and to avoid a 'ranking' system of universities. Brief content analysis was performed on free-text responses, with comments reported verbatim within our Results.

Response rate and demographics

Thirty-five out of sixty UKRN Local Networks (58.3%) provided data for this questionnaire, with 1,274 individuals responding in total. Respondent characteristics are outlined in Table 1.

Table 1. Demographics of sample across UKRN institutions (n=1,274).

Research discipline*	**n/%**
Psychology	n=216 / 17%
Physical sciences	n=139 / 11%
Medicine & dentistry	n=126 / 9.9%
Subjects allied to medicine	n=123 / 9.7%
Biological and sport sciences	n=111 / 8.7%
Social sciences	n=87 / 6.8%
Engineering and technology	n=85 / 6.7%
Computing	n=54 / 4.2%
Mathematical sciences	n=44 / 3.5%
Veterinary sciences	n=43 / 3.4%
Geographical and environmental studies	n=30 / 2.4%
Education and teaching	n=22 / 1.7%
Agriculture, food and related studies	n=20 / 1.6%
Business and management	n=17 / 1.3%
General and others in sciences	n=17 / 1.3%
Humanities and liberal arts (non-specific)	n=15 / 1.2%
Creative arts and design	n=14 / 1.1%
Language and area studies	n=14 / 1.1%
Communications and media	n=8 / 0.6%
Historical, philosophical and religious studies	n=7 / 0.5%
Law	n=7 / 0.5%
Architecture, building and planning	n=6 / 0.5%
Combined and general studies	n=3 / 0.2%
No response	n=66 / 5.2%
Research methods experience	
Quantitative	n=544 / 43%
Mixed	n=417 / 33%
Qualitative	n=111 / 8.7%
Other	n=14 / 1.1%
No response	n=188 / 15%
Career Level	
PhD student	n=251 / 20%
Professor	n=236 / 19%
Senior Lecturer	n=167 / 13%

Research Fellow	n=153 / 12%
Lecturer / Assistant Professor	n=135 / 11%
Reader	n=81 / 6.4%
Senior Research Fellow	n=69 / 5.4%
Other	n=92 / 7.2%
No response	n=90 / 7.1%
Member of a Research Group	n=956 / 75%
Current member of institution's Open Research Working Group	n=112 / 8.8%
Interested in being involved in Open Research initiatives at institution	n=696 / 55%
Aware of the UK Reproducibility Network (UKRN)	n=462 / 36%

Note: * Data collected and presented using HESA's Common Aggregation Hierarchy https://www.hesa.ac.uk/support/documentation/hecos/cah-list.

Awareness and use of Open Research practices

Of the 1,274 respondents, most were aware of Open Access publications (94.1%), Preprints (85.3%), Open Data (83.4%), Open Peer Review (71.4%), Open Code (69.2%), Open Research (68.7%), Replication studies (67.7%) and Open Materials (66.1%; Table 2). Respondents were least aware of Registered Reports (38.1%) and study Preregistration (50.8%). Respondents reported having most used Open Access publications (76.5%), Preprints (55.7%) and Open Data (49.7%) and having least used Registered Reports (8.3%) and Replication studies (14.9%; Table 2).

Table 2. Open Research awareness and engagement across UKRN institutions (n=1,274).

	I'm aware of this	**I've used this**	**Not applicable to my research**
Open Research *(sometimes referred to as Open Scholarship or, in a more narrow application, Open Science)*	n=875 / 68.7%	n=489 / 38.4%	n=39 / 3.1%
Study Preregistration *(e.g., pre-analysis plan, prospective registration)*	n=647 / 50.8%	n=299 / 23.5%	n=90 / 7.1%
Registered Reports *(format of empirical article where a study proposal is reviewed before the research is undertaken)*	n=485 / 38.1%	n=106 / 8.3%	n=53 / 4.2%
Open Materials	n=842 / 66.1%	n=438 / 34.4%	n=100 / 7.8%

(making research materials publicly available e.g experiments, questionnaires, intervention materials)			
Open Data *(making research data publicly available, e.g FAIR data)*	n=1063 / 83.4%	n=633 / 49.7%	n=68 / 5.3%
Open Code *(making analysis code publicly available)*	n=881 / 69.2%	n=447 / 35.1%	n=131 / 10.3%
Preprints *(making research papers available prior to journal peer-review in an online repository)*	n=1087 / 85.3%	n=709 / 55.7%	n=19 / 1.5%
Open Peer Review *(journal or grant peer review where authors and reviewers are aware of each other's identity)*	n=910 / 71.4%	n=408 / 32%	n=20 / 1.6%
Open Access Publication *(making peer-reviewed papers or other publications publicly available)*	n=1199 / 94.1%	n=975 / 76.5%	n=21 / 1.6%
Replication Studies *(research attempting to reproduce the methods and findings of prior research)*	n=863 / 67.7%	n=190 / 14.9%	n=109 / 8.6%
Research Co-Production *(researchers, public and practitioners working together in research, sharing responsibility throughout a project)*	n=684 / 53.7%	n=240 / 26.7%	n=42 / 3.3%

Support required to increase Open Research practices

The most commonly reported support required to enable Open Research were incentives from funders, institutions or other regulators (51%), dedicated funding for Open Research (46.2%), recognition of Open Research in promotion and recruitment criteria (39.6%), more training using Open Research practices (38%) and more information on Open Research practices (37.3%; Table 3). 2.6% said no strategies were needed to increase Open Research and 1.5% reported not planning to take up Open Research practices.

Table 3. Recommended strategies to increase Open Research practices across UKRN institutions (n=1,274).

Strategy to increase Open Research	COM-B component	n/%
Incentives from funders, institutions or other regulators	Social opportunity	n=650 / 51%
Dedicated funding for Open Research	Physical opportunity	n=589 / 46.2%
Recognition of Open Research in promotion and recruitment criteria	Social opportunity	n=504 / 39.6%
More training using Open Research practices	Psychological capability	n=484 / 38%
More information on Open Research practices	Psychological capability	n=475 / 37.3%
More time	Physical opportunity	n=421 / 33%
Support from senior researchers (e.g., supervisors and principal investigators)	Social opportunity	n=369 / 29%
Supporting infrastructure (e.g., sufficient storage for Open Data)	Physical opportunity	n=365 / 28.6%
Workload dedicated to Open Research	Physical opportunity	n=349 / 27.4%
Understanding ethical issues (e.g., issues around data sharing)	Psychological capability	n=333 / 26.1%
Need for more positive beliefs about Open Research	Reflective motivation	n=147 / 11.5%
Support from junior researchers (e.g., PhD students, early career researchers)	Social opportunity	n=68 / 5.3%
I do not plan to take up Open Research practices	Reflective motivation	n=19 / 1.5%
Nothing		n=33 / 2.6%
Additional strategies suggested		n=87 / 6.8%

Note: Respondents were asked to select up to 5 options.

Additional free-text comments were provided by 6.8% of respondents to extend what strategies would be helpful to use more Open Research practices (Table 4). Eleven themes (Themes 1-11) were identified across the responses, with all free-text responses provided available in the dataset on OSF: https://osf.io/qt6b8/.

Table 4. Themes with example quotes from free-text responses received within Brief Open Research Survey across UKRN institutions

Theme 1: Support for "Incentives from funders, institutions or other regulators"		
"More incentives from my institution leadership to practice open science. I feel they do not recognise the relevance of open science"	*"I'm not sure it's incentives that are needed (i.e. funds), but if there is to be uptake then Open Research needs to be part of the evaluation criteria of the funder"*	
Theme 2: Support for "Dedicated funding for Open Research"		
"*Money to pay for open access publications! I am all for open access, and it increases citations, which is a bonus but it's SO EXPENSIVE!"*	*"[my institution] does have funding for publishing open access articles but the budget is too low*"	"*Institutional support for open access fees where funder is too small to cover this themselves*".
Theme 3: Support for "Recognition of Open Research in promotion and recruitment criteria"		
"*Institutional changes (both intra-university and inter-university), such as more responsible use of metrics and organisational structure that leads to actively promoting the uptake of open science practices"*	*"rewards for career"*	
Theme 4: Support for "More training using Open Research practices"		
"*talks I find online expect some knowledge, but also aren't 'training' Make it feel less intimidating - seeing people online be critical of those who make mistakes makes me nervous of trying*"	*"Better resources/guidance on accessing data and code etc - currently the location of this material is very disparate*"	"*More training, guidance, or protection against some of the real and perceived risks of open research, e.g., stealing of ideas, public embarrassment, use of data without credit, public or media misuse of preprint info etc*"
Theme 5: Support for "More information on Open Research practices"		
"*how to apply these practices in Open an*(d) *Social Science setting*"	"*Clear rules surrounding the release of medical datasets / machine learning models*."	*"more subtlety and understanding of the issues and meanings of terms (beyond just ethical issues) would be helpful"*

Theme 6: Support for "Support from senior researchers (e.g., supervisors and principal investigators)"		
"*Ensuring Vice Chancellors support and agree that OS and OA are important and mission critical. Moving the dial on institutional change has to be led from the top and is still considered a side issue for very senior leadership*"	*"Initiative by the leading research figures in my field"*	
Theme 7: Support for "Supporting infrastructure (e.g., sufficient storage for Open Data)"		
"Administrative support/IT support to put things in the correct format, add meta data, etc"	*"More effective data management systems within host organisation. More effective tools for on-line collaboration on projects"*	"*the biggest challenge here is making data publicly available over a long period, when the funding to maintain the datastore runs out*"
Theme 8: Support for "Understanding ethical issues (e.g., issues around data sharing)"		
"*More recognition about qualitative research - which cannot always be open without putting the identity of participants at risk*"	"*Understanding around legal and information governance issues (beyond ethics)"*	"*Ethics committee understanding the benefits and making it simpler to share data (currently we have to jump through extra hoops to share research data online)*"
Theme 9: Need for increased acceptance of Open Research by journals		
"*Change of attitude from publishers. There are still many journals which do not accept submissions that have been shared as preprints*"	*"Journals need to take OS more seriously - especially replication"*	"*complete overhaul of academic journal publication system! towards a more open approach to reporting academic research conduct and results*"
Theme 10: Need for reduced number of Open Research platforms	**Theme 11: Consequences for those not doing Open Research**	***Theme 12: Support for "More time"***
"*Platform reduction - currently there is a trend for even more platforms, most of which have only a modicum of distinctiveness*"	"*Sticks for those that continue to publish in a non-open manner. Senior (Prof level) staff continue to be able to just get away with it, and seem to be a barrier to culture change"*	"*Problem is time not whether I think this is a good idea*" "supporting proper open access code/data requires time!"

Theme 13: Lack of personal benefits	Theme 14: Prevalence of short-term contracts
"*The effort is very worth it for the subject, but hardly ever for the researcher who just gets additional work*" *"there is no real benefit to the individual researcher in putting in extra work to ensure their work is 'open'"*	*"I would be interested if I was on a long-term contract and had the time for no-project-specific work"*

Theme 15: Querying usefulness of Open Research		
"*Why the hassle?"* "*Open research is a waste of time distracting us from more important issues. May be important in medicine but in other disciplines it is holding us back*"	"*What is the obsessions psychologists have with reproducibility?! Best advice is just to stop doing all their research on students...*"	"*Much of these seems so specific to quantitative research - I share pre pubs and so on, but in my view qualitative research and data are not suited to aspects of Open Research in various ways.*"
"Much of these seems so specific to quantitative research - I share pre pubs and so on, but in my view qualitative research and data are not suited to aspects of Open Research in various ways."	*"There is an assumption in this survey that all of the open research practices are good and the questions are heavily leading in that direction!"*	

Many of these responses supported or gave elaborations on the items provided within the questionnaire. The most popular strategy "Incentives from funders, institutions or other regulators" was supported by various quotes (Theme 1; Table 4). The second most popular strategy of "Dedicated funding for Open Research" was supported by many quotes focused on the high costs of Open Access publishing (Theme 2), alongside a lack of institutional financial support for gold Open Access publishing. The strategy of "Recognition of Open Research in promotion and recruitment criteria" was extended by comments to include a need for career recognition beyond institutional initiatives alone (Theme 3). The strategy of *"*More training using Open Research practices" was supported by comments (Theme 4) reflecting a need for easily accessible training aimed at non-experts, a need for unification of resources: and training specifically aimed at negating potential risks of Open Research. The strategy of "More information on Open Research practices" was extended by comments (Theme 5) to require a focus on application to different disciplines and specific data types. "Support from senior researchers (e.g., supervisors and principal investigators)" was extended by comments (Theme 6) to include role modelling by senior institutional figures and disciplinary leaders. The strategy of *"*Supporting

infrastructure (e.g., sufficient storage for Open Data)" was extended (Theme 7) to include specific required resources, including personnel and software. Finally, the strategy of "Understanding ethical issues (e.g., issues around data sharing)" was extended (Theme 8) to highlight an emphasis on qualitative research, a need for broader support beyond ethics alone and a need for upskilling in staff assessing ethical applications.

Additional strategies to increase uptake of Open Research were also provided in free-text comments. First, a need for increased acceptance of Open Research by journals was suggested (Theme 9), reflecting a need for more positive attitudes and evident behaviours in journals and publishers to support Open Research, with more zealous comments called for a new global overhaul to academic publishing. Second, some comments called for a reduced number of Open Research platforms (Theme 10). Finally, calls for consequences and shaming for those not doing Open Research was also a recommended strategy (Theme 11).

Additional free-text comments

Additional free-text comments were provided by 6.5% of respondents to the final optional question of the questionnaire: 'Do you have any other comments?'. Six themes (Themes 5, 7, 12-15; Table 4) were identified across the responses to this question, with all free-text responses provided available in the dataset on OSF: https://osf.io/qt6b8/.

Some comments reflected a desire to learn more about Open Research (Theme 5) and a lack of infrastructure to sustain Open Research data in the long-term (Theme 7). Reported barriers to integrating Open Research behaviours included a lack of time (Theme 12), a lack of personal perceived benefits (Theme 13) and high prevalence of short-term academic contracts (Theme 14). Other comments queried the usefulness of Open Research (Theme 15), including questioning the relevance of Open Research beyond medicine and the social sciences, and the relevance of Open Research within qualitative research.

Discussion:

We developed a brief and standardised questionnaire to measure awareness of, engagement in and support required for practicing Open Research across disciplines. In a sample of 1,274 respondents based at Higher Education institutions in the United Kingdom spanning multiple career stages and research disciplines, the data indicate that most respondents were aware of Open Access publications (94.1%), Preprints (85.3%) and Open Data (83.4%) and least aware of Registered Reports (38.1%) and study Preregistration (50.8%). Respondents reported a similar pattern for usage, having most used Open Access publications (76.5%), Preprints (55.7%) and Open Data (49.7%) and having least used Registered Reports (8.3%) and Replication studies (14.9%). These data can be used to tailor education and training initiatives to support engagement and uptake of Open Research practices and to track the trajectory of Open Research over time. This openly available resource also allows for reuse by other researchers and groups (e.g., research institutes, funders) and, due to its brief nature, can be incorporated alongside other measures in meta research.

Support required to increase Open Research practices

The most commonly reported support required to enable Open Research in respondents were incentives from funders, institutions or other regulators (51%: social opportunity), dedicated funding for Open Research (46.2%: physical opportunity), Recognition of Open Research in promotion and recruitment criteria (39.6%: social opportunity), more training using Open Research practices (38%: psychological capability) and more information on Open Research practices (37.3%: psychological capability).

Social opportunity, which includes support from social structures and colleagues to engage with Open Research in the context of this study, was the 1st and 3rd most requested behaviour change component by respondents to support Open Research. The need for such support from wider social structures to facilitate Open Research has been previously discussed in meta research on preregistration (Osborne & Norris, 2022) and Registered Reports (Chambers & Tzavella, 2022), and is supported by Early Career Researchers (Kowalczyk et al., 2022; Zečević et al., 2021) and Open Research networks such as the UKRN (Stewart et al., 2022). Whilst there has been promising progress to incentivise, recognise and reward Open Research practices, including within journals (e.g., via badges; Kidwell et al., 2016) and across them (e.g., via TOP factor assessment; Nosek et al., 2016), by funders (e.g., Registered Reports funding partnerships; (Clark et al., 2021; Drax et al., 2021), and some institutions (e.g., European Universities

Association, 2022), uptake remains limited. More work is needed to ensure a unified, coordinated response from research stakeholders and institutions (Stewart et al., 2022). For example, a recent assessment of 305 job advertisements from 91 global institutions identified that only 0.6% had explicit mention of Open Research across career levels (Khan et al., 2022).

Physical opportunity, in having the time and resources to engage with Open Research in the context of this study, was the 2nd most requested behaviour change component by respondents. Calls for funding schemes to examine and increase Open Research within disciplines have been prominently recommended (Morillo, 2020; Severin & Egger, 2021), with an increasing number of funding calls being established to facilitate this (Dutch Research Council, 2021; Wellcome, 2021). Obtaining grants to research and increase Open Research behaviours will facilitate researchers being allocated the time and resources by their institutions to engage with these behaviours, whilst simultaneously providing a route for social opportunity. Nevertheless, it is important to note that such funding support will only provide physical opportunity for applicants who are successful. Short-term contracts, highly prevalent at pre- and post-doctoral career levels, also emphasise the need for quick research over quality and transparent research (Allen & Mehler, 2019). Wider culture change is required to adopt and recognise the need for slow science (Frith, 2020) to enable high-quality, transparent, rigorous, robust, replicable and reproducible research. Evaluations of Open Research should be embedded in national research frameworks and institutional research agendas with others following similar initiatives (Stewart et al., 2022) such as the European University Association Open Science Agenda 2025 (European Universities Association, 2022).

Psychological capability, insufficient knowledge and skills to engage with Open Research, in the context of this study, was the 4th and 5th most requested behaviour change component by respondents. Open Research training resources to facilitate psychological capability are being developed by numerous organisations, such as the Framework for Open & Reproducible Research Training (FORRT; e.g., Azevedo et al., 2022; Pownall et al., 2021), and training for Open Research practices is being implemented by organisations, such as the UKRN (e.g., Towse et al., 2020) and beyond (Egan et al., 2020). Open Research training is also evident in some UKRN institutions (University of Reading, 2022; University of Surrey, 2022), largely tailored to their own institutional staff and students. However, the wider uptake of these resources across disciplines and institutions remains unclear (Pownall et al., 2022), as evidenced by the reported need for training and information seen in this study. Further support is needed to facilitate

completion of existing training, as well as a need to fill gaps in training provision. It is also evident from our data that such training is wanted, and it would be fruitful to explore any potential barriers to this in future work (i.e., whether there is a problem with uptake of training due to time constraints/pressures on researchers or a lack of training opportunities being provided by institutions and research organisations). For example, the need for increased accessibility of Open Research training and support from feminist and intersectional perspectives has been highlighted (Pownall, Talbot, et al., 2021; Sabik et al., 2021; Whitaker & Guest, 2020), as well as the need for increased relevance beyond quantitative methods to qualitative and mixed methods research (Branney et al., 2019; Humphreys et al., 2021).

Strengths and Limitations

Strengths of this study include the distribution and completion of this questionnaire across a wide range of UK Higher Education institutions, career levels and research disciplines, ensuring relevance across researchers, research domains and methodologies. Furthermore, the strengths of the questionnaire itself include being brief and standardised across research disciplines and offering individual institution-level data to Local Network Leads to enable evidence-based institutional initiatives and change to be developed. A limitation of this research, however, is that the sample is self-selected. All of the participating institutions have already made some commitment to Open Research by having grassroots UKRN Local Network Leads in place. It may be likely that awareness and engagement of Open Research practices has been somewhat overestimated here due to response bias, with researchers who are already aware and engaging in these practices being more likely to respond. Nevertheless, this questionnaire can be distributed in future years to longitudinally assess changes in awareness of, engagement in, and barriers for Open Research, both across and beyond UKRN institutions.

Conclusion:

The development of an open, brief, and standardised measure of Open Research awareness, engagement and support was required to facilitate assessment of practices within and across academic institutions. We developed a questionnaire via iterative revisions through reviews of previous related questionnaires, peer-review and piloting, before rolling it out to UKRN institutions (k=35 institutions, n=1,274). Underpinned by the COM-B model of behaviour change, we found that social opportunity (i.e., incentives from funders, institutions or other regulators), physical opportunity (i.e., dedicated funding for Open Research) and psychological capability (i.e., more information and training using Open

Research practices) were seen by academics as support that would most help them to use more Open Research practices. This questionnaire can be used to collect longitudinal data to examine the trajectory of Open Research, and inform strategy to develop Open Research practices. This questionnaire can also be used to generate global estimates of Open Research awareness and engagement and has already received interest to be rolled out by international Reproducibility Networks with minor modifications, such as translation and terminology changes.

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Supplementary File 1. Responses to piloting of brief questionnaire at Brunel University London

Supplementary Table 1. Demographics of pilot sample (n=235).

Research discipline*	**n/%**
Computing	23/235 (9.8%)
Engineering and technology	19/235 (8.1%)
Social sciences	19/235 (8.1%)
Business and management	18/235 (7.7%)
Subjects allied to medicine	16/235 (6.8%)
Biological and sport sciences	14/235 (6%)
Psychology	11/235 (4.7%)
Law	10/235 (4.3%)
Education and teaching	5/235 (2.1%)
Humanities and liberal arts (non-specific)	3/235 (1.3%)
Mathematical sciences	3/235 (1.3%)
Combined and general studies	2/235 (0.9%)
Geographical and environmental studies	2/235 (0.9%)
Physical sciences	2/235 (0.9%)
Architecture, building and planning	1/235 (0.4%)
Agriculture, food and related studies	1/235 (0.4%)
General and others in sciences	1/235 (0.4%)
Historical, philosophical and religious studies	1/235 (0.4%)
Medicine & dentistry	1/235 (0.4%)
Communications and media	0/235 (0%)
Creative arts and design	0/235 (0%)
Language and area studies	0/235 (0%)
Veterinary sciences	0/235 (0%)
No response	83/235 (35.3%)
Research methods experience	
Mixed	70/235 (29.8%)
Quantitative	38/235 (16.2%)
Qualitative	28/235 (11.9%)
Other	4/235 (1.7%)
No response	95/235 (40.4%)
Career Level	
Doctoral Researchers	82/235 (34.9%)
Lecturer	18/235 (7.7%)
Senior Lecturer	16/235 (6.8%)
Professor	12/235 (5.1%)
Research Fellow	9/235 (3.8%)
Reader	7/235 (3.0%)
Senior Research Fellow	1/235 (0.4%)
Other	4/235 (1.7%)
No response	86/235 (36.6%)
College	
College of Health, Medicine and Life Sciences (CHMLS)	53/235 (22.6%)

College of Business, Arts and Social Sciences (CBASS),	51/235 (21.7%)
College of Engineering, Design and Physical Sciences (CDEPS)	49/235 (20.9%)
Brunel Centre for Advanced Solidification Technology (BCAST)	2/235 (0.9%)
Missing	80/235 (34%)
Member of a Research Group	63/235 (26.8%)
Current member of institution's Open Research Working Group	14/235 (6.0%)
Interested in being involved in Open Research initiatives at institution	103/235 (43.8%)
Aware of the UK Reproducibility Network (UKRN)	26/235 (11.1%)

Note: * Data collected and presented using HESA's Common Aggregation Hierarchy https://www.hesa.ac.uk/support/documentation/hecos/cah-list.

Supplementary Table 2. Open Research awareness and experience across pilot sample (n=235).

	I'm aware of this	I've used this	Not applicable to my research
Open Research *(sometimes referred to as Open Scholarship or, in a more narrow application, Open Science)*	n=123 / 52.3%	n=67 / 28.5%	n=9 / 3.8%
Study Preregistration *(e.g., pre-analysis plan, prospective registration)*	n=59 / 25.1%	n=32 / 13.6%	n=7 / 3.0%
Registered Reports *(format of empirical article where a study proposal is reviewed before the research is undertaken)*	n=54 / 23%	n=21 / 8.9%	n=7 / 3.0%
Open Materials *(making research materials publicly available e.g experiments, questionnaires, intervention materials)*	n=112 / 47.7%	n=57 / 24.3%	n=7 / 3.0%
Open Data *(making research data publicly available, e.g FAIR data)*	n=124 / 52.8%	n=63 / 26.8%	n=6 / 2.6%
Open Code *(making analysis code publicly available)*	n=149 / 36.6%	n=36 / 15.3%	n=16 / 6.8%
Preprints *(making research papers available prior to journal peer-review in an online repository)*	n=108 / 46%	n=56 / 23.8%	n=2 / 0.9%
Open Peer Review *(journal or grant peer review where authors and reviewers are aware of each other's identity)*	n=115 / 48.9%	n=52 / 22.1%	n=1 / 0.4%
Open Access Publication *(making peer-reviewed papers or other publications publicly available)*	n=156 / 66.4%	n=109 / 46.4%	n=1 / 0.4%
Replication Studies *(research attempting to reproduce the methods and findings of prior research)*	n=95 / 40.4%	n=18 / 7.7%	n=9 / 3.8%
Research Co-Production *(researchers, public and practitioners working together in research, sharing responsibility throughout a project)*	n=97 / 41.3%	n=43 / 18.3%	n=4 / 1.7%

Supplementary Table 3. Recommended strategies to increase Open Research practices across pilot sample (n=235).

Strategy to increase Open Research	COM-B component	n/%
More information on open research practices	Psychological capability	n=92 / 39.1%
More training using open research practices	Psychological capability	n=81 / 34.5%
Dedicated funding for open research	Physical opportunity	n=64 / 27.2%
Incentives from funders, institutions or other regulators	Social opportunity	n=61 / 26%
Support from senior researchers (e.g., supervisors and principal investigators)	Social opportunity	n=55 / 23.4%
Understanding ethical issues (e.g., issues around data sharing)	Psychological opportunity	n=53 / 22.6%
Supporting infrastructure (e.g., sufficient storage for open data)	Physical opportunity	n=49 / 20.9%
Recognition of open research in promotion and recruitment criteria	Social opportunity	n=44 / 18.7%
More time	Physical opportunity	n=36 / 15.3%
Workload dedicated to open research	Physical opportunity	n=33 / 14%
Need for more positive beliefs about open research	Reflective motivation	n=29 / 12.3%
Support from junior researchers (e.g., PhD students, early career researchers)	Social opportunity	n=20 / 8.5%
Nothing		n=4 / 1.7%
I do not plan to take up open research practices	Reflective motivation	n=2 / 0.9%
Additional strategies suggested		n=10 / 4.3%

Note: Respondents were asked to select up to 5 options.

Supplementary File 2. Brief Open Research Survey (BORS)

Q1. What university/institution are you based at?

Q2. What department of this university/institution are you based at?

Q3. Are you a member of a Research Group at this university/institution? (Yes (If yes: name)/No)

Q4a. Which of the following research practices are you aware of? Tick all that apply (Yes/No)

Open Research (sometimes referred to as Open Scholarship or, in a more narrow application, Open Science); study Preregistration (e.g., pre-analysis plan, prospective registration); Registered Reports (format of empirical article where a study proposal is reviewed before the research is undertaken); Open Materials (making research materials publicly available e.g., experiments, questionnaires, intervention materials); Open Data (making research data publicly available, e.g., FAIR data); Open Code (making analysis code publicly available); Preprints (making research papers available prior to journal peer-review in an online repository); Open Peer Review (journal or grant peer review where authors and reviewers are aware of each other's identity); Open Access Publication (making peer-reviewed papers or other publications publicly available); Replication Studies (research attempting to reproduce the methods and findings of prior research), Research Co-Production (researchers, public and practitioners working together in research, sharing responsibility throughout a project)

Q4b. Which of the following research practices have you used? Tick all that apply (I've used this/I haven't used this/Not applicable to my research)

Response items as above

Q5. What would help you to use more Open Research practices? Please select up to 5.

More information on Open Research practices; More training using Open Research practices; Understanding ethical issues (e.g., issues around data sharing); Supporting infrastructure (e.g., sufficient storage for open data); More time; Workload dedicated to Open Research; Dedicated funding for Open Research; Incentives from funders, institutions or other regulators; Recognition of Open Research in promotion and recruitment criteria; Support from senior researchers (e.g., supervisors and principal investigators); Support from junior researchers (e.g., PhD students, early career researchers); Need for more positive beliefs about Open Research; I do not plan to take up Open Research practices; Nothing; Additional (free text response)

Q6. What discipline do you research in? Pick the discipline most relevant. Note: Using HESA's Common Aggregation Hierarchy https://www.hesa.ac.uk/support/documentation/hecos/cah-list.

Medicine & dentistry; Subjects allied to medicine; Biological and sport sciences; Psychology; Veterinary sciences; Agriculture, food and related studies; Physical sciences; General and others in sciences; Mathematical sciences; Engineering and technology; Computing; Geographical and environmental studies; Architecture, building and planning; Humanities and liberal arts (non-specific); Social sciences; Law; Business and management; Communications and media; Language and area

studies; Historical, philosophical and religious studies; Creative arts and design; Education and teaching; Combined and general studies

Q7. How would you describe the research methods you use?

Quantitative; Qualitative; Mixed; Other (free text response)

Q8. What is your career level?

Professor; Reader; Senior Lecturer; Lecturer; Senior Research Fellow; Research Fellow; PhD student; Other (free text response)

Q9. Are you a current member of your institution's Open Research Working Group? (Yes/No)

If no: Would you be interested in being involved in Open Research initiatives at your institution? (Yes/No)

Q10. Are you aware of the UK Reproducibility Network? (Yes/No)

Q11. Do you have any other comments? (free text response)