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Enablers and Inhibitors of Research Integrity

Foreword

Integrity is a cornerstone of excellent research that is able to ensure lasting, positive difference to our world. Equally, the presence of research integrity safeguards confidence in UK research.

At the UK Committee on Research Integrity we understand research integrity through the well-recognised principles of rigour; transparency and open communication; care and respect; honesty; and accountability. Through application of these principles, we can understand practice and systems that support research integrity.

The UK Committee on Research Integrity has heard from across the research sector that system-wide factors may enhance or inhibit high integrity. We commissioned this report to understand whether there is evidence for these views, and what any such evidence looks like. The report makes use of the principles of research integrity, and has been produced by Circlera: a partnership between the UK Reproducibility Network, The UK Research Integrity Office and the Science Policy Unit at the University of Sussex. We are grateful to all those involved for their work.

This report describes recent literature about enablers and inhibitors of research integrity in the UK. Inevitably, any review of the literature takes place at one point in time, while the research sector and evidence about it continue to mature. We therefore invite readers to consider what the report tells them about recent enablers and inhibitors of research integrity. We also encourage readers to draw on this report to identify further work that is needed to deepen and broaden our knowledge. Doing so will ensure that actions taken to support research integrity are grounded in an evidence base.

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Executive summary

This report describes the evidence base for enablers and inhibitors of research integrity, as defined by the [Concordat to Support Research Integrity](#). Specifically, it describes evidence as it relates to suggestions and opportunities for interventions to promote research integrity in the UK, as proposed in recently published academic and grey literature. Structurally the evidence is framed with reference to the broad components of the research system seen as most relevant to the given enabler/inhibitor. The report aims to draw upon the literature as found and reviewed, without going beyond the existing evidence. Details on the methodological choices and limitations are available at the end of the document, although one limitation should be highlighted at the outset. That is, most of the literature covered by this report is primarily concerned with research integrity as it is typically defined and considered in quantitative, empirical research. There are several possible reasons for this, discussed further in the report, but the implication is that additional work would be needed to find and assess any relevant literature focused on, for example, the arts and humanities.

Summary of findings:

Enablers and inhibitors of research integrity tend to be systemic, and so any presentation of them with a particular focus will inevitably be approximate. The findings are described here around three broad constituents of the research ecosystem: culture and institutions, publishing and dissemination channels for research, and researchers themselves.

Culture and institutions

- **Publication pressures** within competitive research environments, and biases in patterns of publication, are seen as systemic inhibitors of research integrity and are regularly linked to researcher-level inhibitors of integrity such as questionable research practices (QRPs).
- **Shifts in assessment styles**, away from narrow quantity and citation-based metrics as used in several fields and disciplines, and toward more nuanced and varied methods of judgement (e.g., qualitative expert assessment) in employment and funding decisions may help ameliorate pressures leading to QRPs and biases in publication patterns.
- Evidence for these drivers and interventions is predominantly based on expert opinion and self-report data.

Publishing and dissemination channels

- Development of appropriate infrastructure for, and the promotion and recognition of engagement with open research practices such as **preregistration and sharing of records such as data** may incentivise greater transparency and encourage research integrity.
- The **“file drawer problem”**, whereby null results or other results perceived as “unexciting” are not published or even written up, may lead to pressure to engage in QRPs to find publishable results. It does lead to a scholarly record that is not an accurate representation of the research evidence. Accessible avenues for the publication of

rigorous but “unexciting” research can help address these inhibitors of research integrity.

- Evidence for these interventions comprises some empirical support for efficacy but spread and uptake of the practices are limited.

Researchers

- **Training** in responsible research methods can lead to positive changes in attitude and awareness. There is good evidence that training can change knowledge and attitudes, but not that it leads to direct changes in behaviour.
- **Mentoring** from positive role models that includes clear guidance on research integrity can be influential in early and mid-career researchers’ research practice. There is good evidence that mentoring has positive effects given able, informed mentors.

Limitations

- The available literature on research integrity is heavily **skewed toward quantitative academic research**.¹ **Qualitative research and research outside academia is underrepresented**. The quantitative bias appears partially a result of variance in the language used across disciplines to discuss overlapping goals or practices, and partly a result of differences in epistemic commitment and therefore the goals and practices themselves. Research about research, science studies, or policy work should take note of these differences when compiling evidence intended to cross disciplinary boundaries. In particular, further work would be required to map how the principles of research integrity function, and what factors inhibit or enable research integrity, in domains that are underrepresented in this report.
- In many cases, empirical **evidence of efficacy and effectiveness** of interventions is **lacking**, most recommendations in the literature are based on survey data and expert opinion.²

1 That is research which produces and uses numerical (quantitative) data, normally in combination with statistical hypothesis testing procedures, as opposed to research for which the data produced is nonnumerical (qualitative) often in the form of language. These differing forms of data are (not exclusively) associated with different research disciplines; the quantitative research most frequently addressed in the research integrity literature reviewed here for instance comes from biomedical fields. Research in industry may take elements of both of these forms, but may also focus more on the functioning of output within a market rather than knowledge production per se.

2 Efficacy relating to the potential for producing an effect, effectiveness being the actual production of that effect in the intended settings.

Enablers and Inhibitors of Research Integrity Findings

The sections comprising this report represent areas of research integrity regularly discussed and considered important in the review literature. The report is structured around three broad constituents of the research ecosystem: culture and institutions, publishing and dissemination channels for research, and researchers themselves. Although these are overlapping and perhaps overly-simplistic categories, they highlight some of the major places for intervention relevant to each key issue raised in the literature. Enablers of research integrity often involve factors that remove or disincentivise inhibitors of research integrity: they essentially represent two sides of the same coin.

Culture and institution

Publication pressures

There is widespread agreement in findings from analysis of survey data and expert opinion that pressure on researchers to publish frequently and in high prestige journals is a major inhibitor of research integrity.³ Following this, the emphasis on obtaining external research funding can create perverse incentive structures that inhibit integrity. Researchers commonly report the use of journal metrics, citation indices and publication numbers as proxies to judge academics' professional value, and they perceive this use therefore affecting job prospects, reputations, and likelihood that research funding is awarded. These pressures are seen to contribute to the incidence of questionable research practices (QRPs).⁴ Expert opinion and available data suggest that QRPs are a far more prevalent issue for research integrity than fraud or data fabrication.⁵

Arguably, without shifts in both the reality and the perception of how research and researchers are evaluated, substantive advancements in areas such as QRPs, falsification, fabrication and plagiarism (FFP), and other researcher level threats to research integrity will be difficult to achieve.

The *commonly proposed solution* to this issue is that quality of research should be judged more carefully via a variety of criteria and indicators, and that quantity of output should be deemphasized.⁶ Importantly, this includes qualitative judgement by experts of relevant research outputs. Measures for assessing robustness and transparency have also been suggested as additional tools to be used when making decisions that entail judgement of individual researchers and their work.⁷ These solutions may go some way to ameliorating the issue, but qualitative judgements require significant investment of time and expertise from decision-making bodies seeking to assess large numbers of submissions. The development and use of alternative metrics may create alternative incentive structures. However, care is needed to ensure that these lead to the desired outcomes, will not be gamed, or become box ticking exercises necessary to pass obligatory hurdles. Similar issues are discussed with regards to preregistration below.

Interventions suggested in the literature:

- Metric(s) to assess research integrity to be implemented.
- Qualitative, expert judgement to be used in place of/addition to a range of metrics.

Evidence from the literature for the likely success of these interventions is predominantly expert opinion and self-report.

3 See for example, amongst others, Hsing et al. 2023; Pontika et al. 2022; Metcalfe et al. 2020; Aubert Bonn & Pinxton, 2019; Royal Society, 2018; Begley & Ioannidis, 2015; Nuffield Council on Bioethics, 2014.

4 Which compromise the integrity of research, such as 'p-hacking' (using strategies targeted at rendering non-significant hypothesis testing results significant), HARKing (Hypothesising After Results are Known), selective reporting (incomplete or non-reporting of research results in order to suppress negative or undesirable findings), or the related 'cherry picking' (used more frequently in relation to qualitative research), and outcome switching. One survey of researchers reports 51% of respondents regularly engaged in at least one form of QRP, compared to 4% admitting to falsification or fabrication of data (Gopalakrishna et al. 2022). Furthermore, publication pressure was found in this study to be the strongest explanatory factor for these QRPs, a finding that confirms that by Metcalfe et al, 2020.

5 e.g., Grieneisen & Zhang, 2012; HoC, 2018.

6 Probably most famously argued in Hicks et al. 2015 but echoed in all of the above references.

7 See e.g., Pontika et al. 2022.

A number of organisations have implemented change in evaluation processes; in the UK, the Research Excellence Framework (REF) and UKRI, for instance, have made commitments to forgo journal-based metrics.⁸ Consensus in the academic literature however is that there is much work still to be done to ameliorate the negative impact of pressures on the individual researchers while preserving accountability.

Funding bodies

The processes by which research funding is allocated may also function as enablers or inhibitors of research integrity. Beyond the problematic use of metrics discussed above, external pressures in terms of publishing and funding are recognised as playing a crucial role in setting standards for an equitable and fair research culture.⁹ Similarly, 'output related funding', whereby "funders support projects based on the topic attractiveness rather than the quality of research", is a regularly reported inhibitor of research integrity.¹⁰ Pursuance of specific outcomes can also encourage QRPs.¹¹ In one survey, 33% of respondents admitted to having changed study designs in response to pressures from funders.¹² When funding bodies have clear policies and guidelines concerning research integrity, monitor and reward research integrity practices, and develop mechanisms to address misconduct, they are identified as enablers of research integrity.¹³

Suggestions from the literature relating to funding structures include the anonymisation of grant submissions, potential for additional time on short grants, specific funding for groups more likely to experience discrimination, more diversity on funding panels, greater availability of smaller funding awards, and development of simpler application processes with quick turnarounds (e.g., two-phase application process).

Suggestions from the literature for support at the researcher level include provision of specific funding for early career researchers, rewards for those who do not publish (e.g., rewarding ideas as well as the final output), and the creation of clearer road maps of opportunities. Additionally, the promotion and development of programmes to help researchers get started in their careers, including training and continued mentoring (see also section: Mentoring, pg. 11), and events to bring researchers together and provide networking opportunities are posited as potentially valuable interventions.

Beyond reframing evaluation procedures, potential *interventions at the funding criteria and incentives level* include a practice of setting precedents by assessing the health of a research environment, the satisfaction of research teams and the rigour of researchers' work prior to allocating funding, and the potential to include high quality research that is not published in formal outlets as part of assessments.

Interventions suggested in the literature:

- Funding allocation decisions to include assessments of research integrity; demonstrable history of and commitment to open research practices such as preregistration and sharing of records such as data.
- Research integrity practices to be monitored and rewarded throughout funded projects.¹⁴

There is only **limited evidence for the likely success of interventions reported in the literature** that is derived from implementation; most evidence is expert opinion.

8 Raw citation counts are still used by REF.

9 Moran et al., 2020.

10 Roje et al., 2023.

11 Additional pressure may come when funders are linked to industry; medical and nutrition-based research produces pro-industry conclusions 3.6 and 7.6 more frequently when funded by industry than not (Bekelman & Gross, 2003; Lesser, Ebbeling, Goozner, Wypij & Ludwig, 2007).

12 Hsing et al., 2023.

13 Roje et al., 2023.

14 Learning (2020).

Publishing and dissemination channels

Whilst the above issues do involve the publication of research, several factors inhibiting high levels of research integrity can be seen as embedded within practices of publication more specifically. Transparency and openness are key broad components of research integrity relevant in this domain, and most recommendations focus on creating mechanisms through which research and records are published faithfully and accessibly, regardless of the study outcomes.

File drawer

The creation of new avenues for the reporting of 'null results', such as the journal *Wellcome Open Research*, is one suggested enabler of research integrity focused on addressing the "file drawer problem"¹⁵ where good research is not published because it didn't find a publishable, positive effect.¹⁶ Similarly Registered Reports, preregistration, and journals' commitment to publish preregistered studies regardless of results, are seen as useful methods in many disciplines for ameliorating this bias towards publication of positive and exciting results.

In disciplines that rely heavily on statistics, there is a long-standing discussion about high levels of research integrity being inhibited by the preferential publishing of statistically significant results, which leads to a large number of studies being left unpublished (or even unwritten).^{17,18} There is evidence that journals preferentially publish novel and statistically significant studies.¹⁹ This issue is greatly compounded if journals also allow publication of less rigorous studies, which contributes to low replicability where that is a relevant aspect of integrity. While most obvious perhaps in disciplines using statistics, non-publication of rigorous but perhaps inconclusive qualitative research also contributes to the file drawer problem.²⁰

Whilst preregistration of study designs and a commitment to publish rigorous research regardless of its findings can contribute to overcoming the file drawer problem, neither of those enabling factors yet have broad enough reach to solve the issue completely. Open repositories in which authors can publish null findings freely and easily may also contribute to the solution, but generally lack the authority and credibility granted via peer review processes.

Interventions suggested in the literature:

- Avenues for publication of 'null' results to be created and promoted.
- Commitments to be made to publish quality research regardless of outcomes.

Evidence for the likely success of interventions reported in the literature comprises some support for efficacy but the spread and uptake of these interventions are limited.

Preregistration

As elsewhere in this report, this section derives from the search method described in Annex B, leading to an emphasis on issues as they are commonly described in that literature, which may not be equally relevant across disciplines. Preregistration can be defined as the depositing of a study protocol comprising research hypotheses or questions, research design, statistical methods, and/or analysis plan in an accessible repository before collecting and analysing data.²¹ 'Data' here refers to any measurement or observation collected by researchers during the course of a study; thus numbers, text, images etc. are all potentially 'data'. There is active debate on whether and how preregistration may be relevant or appropriate for different kinds of research, and so recommendations in this section may be relevant to, for example, qualitative and quantitative research to varying degrees.²² Preregistration may enable research integrity by enhancing

15 The journals *PLoS ONE* and *Trials* similarly state a focus on validity and rigour over statistical significance.

16 Rosenthal, 1979.

17 'Significance' here in the formal statistical sense of a p value below the chosen alpha value (i.e., not necessarily equivalent to importance or practical significance). That is, the likelihood of producing the given result, under the assumption that there is no difference between groups (or alternative null hypothesis), is lower than a given predetermined value. Results may be 'significant' in this sense even when very small effect sizes are produced (generally if sample sizes are large).

18 This publication bias towards statistically significant results is also seen to contribute to prevalence of QRPs, via publication pressure.

19 e.g., Franco, Malhotra & Simonovits, 2014; Chavalarias et al., 2016; Lin & Chu, 2018.

20 Toews et al. 2016.

21 Hardwicke & Wagenmakers, 2023.

22 See e.g., Kapiszewski & Karcher (2021) on preregistration in qualitative research.

transparency and may protect the credibility and confirmatory status of reported results by detecting or preventing QRPs by 'breaking the link' between the research process and the results produced.^{23,24} Additionally, preregistration (and Registered Reports, a peer-reviewed form of preregistration) may function by making it more difficult to pass off questionable practices as planned and more likely that they are picked up in the review process. In this way, studies including QRPs will be less likely to be published, which in turn may discourage researchers from engaging in such practices. Conversely, preregistration may inhibit integrity via amplifying perceived time pressures, wellbeing concerns, and costs due to the extra work it entails.

Some evidence suggests that the proportion of 'positive' results in preregistered studies and registered reports are lower compared with non-preregistered or non-registered report studies, respectively.²⁵

However, uptake across disciplines and research domains remains low and, even where mandated, the expected benefits of registration do not always follow.²⁶ This extends beyond academic publishing. For example, undisclosed discrepancies between preregistered study plans and their associated publications are still common across clinical science. This is despite the Declaration of Helsinki mandating registration in a publicly available database of all studies involving human subjects, such registration being a condition for ethics approval for clinical trials, supported by services across disciplines to facilitate registration.²⁷ Similar discrepancies between preregistrations and published reports have been found across other disciplines.²⁸

Suggested solutions to the low uptake and poor quality of preregistrations, and discrepancies between them and results reporting, include the establishment of core preregistration

criteria, registration formats that provided a more "structured" workflow with detailed instructions together with an independent review to confirm completeness (for example, Open Science Framework Preregistration), awarding of preregistration badges only to articles that meet the badge criteria, and leveraging complementary workflows that provide a similar function to preregistration.^{29,30}

Interventions suggested in the literature:

- For disciplines where it is appropriate, clear structured workflow for preregistration to be established, with clear quality criteria and independent reviews.

Evidence for the likely success of this intervention reported in the literature is expert opinion and self-reporting.

- Badge system for preregistered studies to be implemented.

Evidence for the likely success of this intervention reported in the literature is ambiguous on its efficacy due to inconsistent implementation. Studies report mixed results, but the best available evidence shows no effect on data sharing.

Data sharing³¹

The sharing of data increases transparency and public accountability, allows for greater scrutiny of research findings, encourages repurposing of data to explore new lines of inquiry, increases confidence in findings, and goodwill between researchers, which can all facilitate improvements in research quality and reproducibility and reduce research waste.³² While the value of data sharing is regularly asserted, empirical evidence for this is limited. This lack of evidence is sometimes partly attributed to the practice of data sharing remaining low across many disciplines compared to goal of

23 Stefan and Schönbrodt, 2023; Munez-Tamayo et al., 2022; Haven et al., 2022; Reid et al., 2015

24 Hsing, et al. 2023.

25 Kaplan & Irvin, 2015; van den Akker et al., 2023; Scheel, Schijven, & Lakens, 2021; Metcalf, Wheat, Munafò & Parry, 2020.

26 Gopalakrishna et al., 2022; Hardwicke et al., 2020; Hardwicke et al., 2021.

27 TARG meta-research group, 2023; Goldacre et al., 2019.

28 TARG meta-research group, 2023.

29 Whilst implementing badges has previously been associated with increasing rate of data sharing (Kidwell et al., 2016); however, stronger evidence from a recent RCT showed no evidence of increased data sharing behaviours (Rowhani-Farid, Aldcroft & Barnett, 2020). Additionally, badges are currently awarded even when preregistration is of low quality and there are undisclosed discrepancies between the preregistration and associated publications.

30 Bakker et al., 2020; Thibault, Pennington, & Munafò, 2023.

31 This section refers to 'data' as the primary evidence on which research draws because that is the term widely used in the literature; a more inclusive term such as 'records' might be preferable but is not widely used. This section refers to 'sharing' to imply data being as open as possible and as closed as necessary, recognising that not all research data can be wholly and immediately open for a wide range of reasons.

32 Yoong et al., 2022; Chawinga & Zinn 2019; Gilmore et al., 2019; Popkin 2019.

it becoming 'standard operating procedure'.³³ Of qualitative researchers, for example, 4% report having ever shared data openly, addiction research similarly sees around 5% of studies published with openly accessible data.³⁴

If, as noted above, data sharing is understood as enabling high levels of research integrity, then the most commonly reported inhibitors of data sharing at the individual level include the increased burden researchers perceive regarding preparing and publishing open data, the preference to share only upon request, fear of being scooped, and concerns about the potential secondary misuse of data.³⁵ Institutional level barriers include a failure of academic institutions to recognise data sharing practices when reviewing, hiring, and promoting researchers, and the lack of data sharing training.³⁶ More global inhibitors discussed in the literature are the high levels of competition between researchers, shortage of repositories to store data, publisher inaction or ineffective or inconsistent journal policies to promote and encourage data sharing, ineffective international policies, ethical, and legal norms, a lack of clarity regarding the status of data sharing in grant applications, and data sensitivity and confidentiality issues in particular for qualitative research in which identification of participants may be more likely.³⁷

To overcome the barriers described above and encourage researchers to share research data, funders could make it a condition of funding, provide financial incentives for those who share data, or offer bridge funding to allow researchers more time to make data available.³⁸ Research institutions and other research stakeholders could invest in infrastructure (e.g., data repositories),

conduct training and advocacy programs, and produce educational materials that demonstrate best practice of where and how data can be shared.³⁹ To establish data sharing as 'standard operating procedure'⁴⁰, research stakeholders must recognise researchers who share data through data citations, acknowledgement, and incentives.⁴¹ When assessing the impact of researchers' work, research institutions can introduce more qualitative metrics, such as evaluating researchers' adherence to open research practices, such as sharing data.^{42,43}

The frequency and quality of data sharing increases when academic journals mandate data sharing by stipulating it as a condition for publication,⁴⁴ and encourage data sharing by for example, referring authors to sharing tools or offering incentives such as awarding badges to those publications that share data.⁴⁵

Interventions suggested in the literature:

- Journals to mandate data sharing, with clear criteria, upon publication.

There is good evidence reported in the literature for the efficacy of this intervention.

- Normalisation and valorisation within research cultures to be promoted by institutions through support and recognition of good practice, and tangible rewards.

Evidence for the likely success of this intervention reported in the literature is predominantly expert opinion and self-report.

33 Gopalakrishna et al., 2022; Adewumi et al., 2021; Mozersky et al., 2021; Houtkoop et al., 2018; Vanpaemel et al., 2015.

34 Adewumi et al., 2021; Mozersky et al., 2021

35 Hsing et al., 2023; Royal Society, 2018; Chawinga & Zinn, 2019; Houtkoop et al., 2018; POSTNote, 2017.

36 Pontika et al., 2022; Chawinga & Zinn, 2019; Houtkoop et al., 2018.

37 Montgomery et al., 2014; Parliamentary Office of Science and Technology, 2017; Hsing et al., 2023; House of Commons, 2022; Chawinga & Zinn, 2019; Houtkoop et al., 2018; Mozersky et al., 2021.

38 Houtkoop et al., 2018; PostNote, 2017.

39 Chawinga & Zinn 2019; Houtkoop et al., 2018.

40 Kretzer et al., 2019; Mebane et al., 2019; Casadevall et al., 2016.

41 Chawinga & Zinn 2019.

42 Roje et al., 2023.

43 Substantial attempts have already been made to instigate some of these recommendations in the UK. For instance, the UK Government's Research and Development Roadmap (2020) has made a commitment to "strongly incentivise open data sharing where appropriate" through, for example, ensuring that digital software and datasets are properly recognised as research outputs. In 2016, the Concordat on Open Research Data, developed by a UK multi-stakeholder group including UKRI, Universities England, and several funders, encourages data sharing while recognising that restrictions may be reasonable and justifiable for some data, acknowledges the right of the creators to reasonable first use, and cautions that the use of others' data should conform to legal, ethical and regulatory frameworks including appropriate acknowledgement.

44 e.g., *Science; Nature, Cognition, and all PLoS journals* require authors to make study protocols, datasets, and code available on publication. Such mandates do not result in ubiquitous transparency and data sharing but do produce significant increases. See Hardwicke et al., 2018 on outcomes re *Cognition*.

45 Vine et al., 2013; Hardwicke et al., 2018; Houtkoop et al., 2018; POSTNote, 2017.

Researchers

Training in Responsible Research Practices

Those whose views are most represented in the literature (researchers and experts) see training as one of the key factors in promoting research integrity. A broad range of stakeholders surveyed in one study would like to see training on responsible research practices (RRP) embedded in curriculum and career development at all levels, with the suggestion that training be customised for career stage and subject area.⁴⁶ A further suggestion is to provide a certification of research integrity training which may be used by funders and institutions. In other words, they would only award grants or offer jobs to people with a current certificate.

Support for the efficacy of training comes from a meta-analysis of 30 studies, which found that training on the responsible conduct of research can be effective in improving knowledge, judgement, orientation and attitude towards RRP.⁴⁷ Whilst no effect was observed in the meta-analysis on behaviour or sensitivity to ethical problems related to research conduct, improved knowledge and attitude can positively impact behaviour in the long term.⁴⁸ Potential risks associated with one off training initiatives include added stress on, and overconfidence of researchers.⁴⁹ Shorter, frequently delivered tailored sessions and mentoring seem to be more efficient forms of training.

Intervention suggested in the literature:

- Targeted and continued training for researchers at all levels.

There is good evidence reported in the literature

for change in knowledge and attitude, but evidence is lacking for direct changes in behaviour

Mentoring

Mentoring has been identified as playing a crucial role in fostering a culture of research integrity in the

reviewed literature.⁵⁰ At the same time, receiving poor or no mentorship is reported as inhibiting good research practice.⁵¹ Mentoring may promote Good Research Practice (GRP) when it comprises clear guidance on RRP, entertaining informal discussions on RRP, explicit instructions on research integrity, and when the mentor acts as a role model, endorsing such practices in their own work. The majority of work looking at the role of mentors in promoting research integrity is limited to the life sciences, however.

One review including 35 published papers on mentors' role in fostering research integrity identifies the need to "develop, document, and promote specific training to educate faculty members to be effective mentors".⁵² Such a requirement is already present in several European countries.⁵³ Another study that investigated five different types of mentorship (research, financial, survival, personal, and ethics) in the biomedical and life sciences in the US found that early career researchers who received financial and survival mentoring were more likely to engage in QRPs than researchers who did not, whereas those who received personal and ethics mentoring engaged in more GRP.⁵⁴

Further research is needed to: 1) assess the impact of different types of training for mentors and 2) assess the impact of different types of mentorships. Thus, whilst there is evidence of mixed effects of mentorship, these studies suggest potential benefits if mentors are trained and knowledgeable, and subscribe to ethical norms.

Intervention suggested in the literature:

- Research integrity to be deliberately included in mentoring via discussion and modelling.

Evidence for the likely success of this intervention reported in the literature is good, given able informed mentors who subscribe to ethical norms.

46 Pizzolato & Dierickx, 2023.

47 Katsarov et al., 2022.

48 Hagger & Hamilton, 2023.

49 Roje et al., 2023.

50 Robshaw, 2020; Royal Society, 2018; Montgomery et al., 2014.

51 Aubert Bonn & Pinxten, 2019.

52 Pizzolato & Dierikx, 2023, p.19.

53 ALLEA, 2023.

54 Anderson et al., 2007.

Limitations

The majority of the available literature reflects the opinions of experts on research integrity and researchers themselves. Although this is valuable in its own right, it does not provide empirical evidence of efficacy for interventions or strategies to promote research integrity. For example, as far as we know, there are no natural experiments where the causal impact of publication pressures could be unambiguously captured. Survey responses and other similar research strategies may therefore be capturing perceptions rather than evidence of effects. Similar arguments can be made for funding pressure, or indeed researchers' welfare related issues.

To illustrate, Roje and colleagues (2023) found in their review of 236 studies of factors influencing the promotion and implementation of research integrity that only 10 described study designs that incorporated interventions with a measure of change from baseline. Half of these studies employed pre- and post- tests, which have their own limitations regarding causal inference, extrapolation and bias, such as experimenter effects. Additionally, two studies were described as randomised controlled trials, known as the 'gold standard' for producing evidence of intervention effects. Most of the 10 concern the efficacy and effectiveness of particular training interventions.

In many of the areas comprising research integrity there is also a difficulty measuring the direct impact of an intervention, particularly over the short term. In order to assess whether or not an intervention reduces some aspect of QRPs, for instance, researchers would likely need to report directly and honestly about engagement in QRPs, and would know beforehand that they would be expected to do so. It is difficult to measure QRPs and many of the other problematic practices that undermine research integrity in a way that does not influence the outcome of the measurement. One sign of this, perhaps, is the differences in responses when researchers are questioned about their own practices compared to their impression of their peers' practices.

Thus, even studies that use interventions and attempt to measure outcomes are largely based on survey or interview post-measures. One feasible form of large sample empirical evidence to assess the impact of changes at a system level would be from a longitudinal (quasi) experimental method. Such a method is not only costly but also very hard to implement when it comes, for example, to the funding structure or to publication pressure. Changes in the REF have reportedly instigated changes in researchers' perceptions of research practice and university assessment practices.⁵⁵ It is therefore plausible to argue that a change in policy in the direction of fostering a more open and responsible research practice (here represented by expert voices' suggestions) will result in a significant improvement in the quality and integrity of research.

Much of the available literature on research integrity focuses on research within academia; particularly quantitative, hypothesis-driven life and health sciences and clinical research.

The quantitative bias appears partially a result of variance in the language used across disciplines to discuss overlapping goals or practices, and partly a result of differences in epistemic commitment and therefore the goals and practices themselves. Thus, the results of this review are applicable most directly to certain domains; caution should be used if extrapolating to other research environments. Furthermore, research about research, science studies, or policy work should take note of these differences when compiling evidence intended to cross disciplinary boundaries.

However, while there are some method-specific issues, some aspects of the funding structure, publication pressure, file drawer and null result elements identified in the review may be common inhibitors of research integrity also in the case of qualitative research. Likewise, preregistration and data sharing may promote transparency and so be enablers of research integrity in qualitative research as they are in quantitative research. While the ideas proposed would translate differently⁵⁶ across

⁵⁵ Weinstein et al., 2019; Pontika et al., 2022

⁵⁶ Chauvette, Schick-Makaroff, & Molzahn, 2019

epistemologies, methodologies and disciplines, we do see value in highlighting some common underlying principles.⁵⁷

The focus on academic research in this review is a product of the literature under review. Whilst work on responsible research and innovation, with greater focus on industry, is garnering increased attention in the UK in recent years, it is likely that differences in the terminology used excluded much of this work from the scope of our search.

Notes on methods

This review has been compiled pragmatically; there is undoubtedly relevant literature that is not addressed here. However, while it is not a systematic review, the structured search elements employed, the breadth of scope of the sources included and the subsequent snowball inclusions based on these provide some confidence that no major areas of the literature have been missed beyond those noted above.

We used a structured and broad scale search of four large databases to identify relevant review literature. The themes which comprise the headings in this review are a result of analysis of these search results. Each theme was then used as the basis for subsequent, less systematic searches (including searches of the references of relevant studies and reviews and asking our expert panel for relevant research they were aware of) to identify recent and relevant research on inhibiting and enabling factors. A number of relevant large scale systematic reviews have recently been published, the findings of which form much of the material in this review. Full references can be found in Annex A. For a full description of the methodology behind this report please refer to Annex B.

Recommendations and assessments of evidence are the product of a combination of frequency of reference in the specific set of literature reviewed, supporting data, expressions of import in these sources, and expert opinion from project team members. These have been reviewed and validated through interviews with external experts, and are therefore informed opinions.

Feedback from stakeholder interviews was largely supportive of the content of the report. Many of the limitations and gaps in the literature noted in this draft were discussed, and where appropriate acknowledgement of these observations is reflected in this report.

Author Contributions

Conceptualization:

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Declarations of Interest

UKRIO

The UK Research Integrity Office (UKRIO) is a not-for-profit established in 2006 to provide independent support on research integrity to the UK research community and the public. UKRIO's vision is that, through our activities, the UK research community is supported to produce work of the highest integrity, quality and efficacy. We work closely with the research community and understand the fundamental challenges it faces.

We pursue these aims through a multi-faceted approach: education via our guidance publications on research practice, training activities and comprehensive events programme; thought leadership and sharing best practice by facilitating discussions about key issues, informing national and international initiatives, and working to improve research culture; and giving confidential expert guidance in response to requests for assistance.

A registered charity, UKRIO promotes and supports good research practice and related fields such as research ethics, research governance, integrity in research design and collaborative research, and good practice in publication and authorship. We provide expert and confidential support across all disciplines of research, from the arts and humanities to the life sciences. We cover all research sectors: higher education, the NHS, private sector organisations and charities. Generously supported by a network of expert volunteers, we help improve the culture and systems of UK research and address poor practice and misconduct.

James Parry (UKRIO) is a member of the cross-sector working group convened to carry out the UKCORI project Addressing poor research practice and research misconduct. He was a member of the project board for the completed UKCORI project Analysis of research integrity annual statements. Both roles are carried out pro bono.

UKRN

UKRN's focus is on the rigour and transparency of research; it defines 'reproducibility' broadly, as being a level of transparency that enables the research process to be reconstructed and its rigour examined by others, as that is meaningful for that kind of research.⁵⁸ UKRN enables collaboration across the research system, between and within communities and stakeholder groups. It offers shared resources, and currently runs the Open Research Programme, supported by Research England, which includes the provision of training and enabling the reform of recruitment and promotion practices by institutions. While UKRN has members from very many disciplines from arts practice to astronomy, the life and biomedical sciences are over-represented at present.

SPRU

SPRU is an interdisciplinary research unit focusing on science, technology and innovation (STI) policy. SPRU's main research areas relate to how STI contributes to tackling global challenges rather than to the research process. However, research at SPRU relies heavily on the funding structures and mechanisms discussed in this report. In common with other research centres, research metrics and successful funding bids, and rankings based thereon, are regularly leveraged in SPRU promotional material. Nevertheless, SPRU has a relatively small substantive stake in the topic of this report.

Committee members

The report was commissioned by the UK Committee on Research Integrity and completed by UKRN, UKRIO and SPRU. It was published in 2024.

The membership of the committee at the time of publication was as follows:

Andrew George (co-chair)
Rachael Gooberman-Hill (co-chair)
Jane Alfred
Nandini Das
Maria Delgado
Louise Dunlop
Ian Gilmore
Chris Graf
Ralitsa Madsen
Jil Matheson
Miles Padgett
Jeremy Watson

58 See the UKRN Terms of Reference for further detail on this: <https://www.ukrn.org/terms-of-reference/>



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