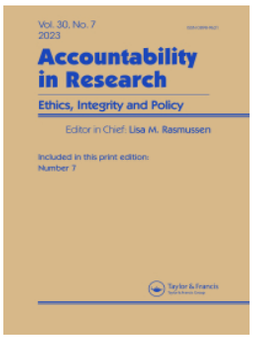

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Shared responsibility to address questionable research practices? – A study of perceived efficacy of organizational research integrity policies

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ABSTRACT

Background: In response to widespread concerns about research integrity, recent years have seen numerous efforts to safeguard against research misconduct and questionable research practices. Research-performing organizations are among the key actors involved in implementing such efforts. However, little is known about the effectiveness of organizational policy initiatives.

Methods and materials: In this study, we investigate the ability of organizations to change researchers' behavior through the perspective of the researcher. We analyze data from the International Research Integrity Survey (IRIS), a survey of researchers in Europe, Canada, Australia, and the USA. We specifically investigate whether researchers' perceptions of their organizations' research integrity policies relate to the degree to which they engage in questionable research practices.

Results: We find that awareness of policies, evaluations of the effectiveness of policies, as well as confidence in their organizations' research integrity policies all relate to lower levels of engagement in questionable research practices. However, we also find that this relationship is highly sensitive to both researchers' research integrity self-confidence and their general attitudes toward research integrity.

Conclusions: As such, while findings indicate that organizations' policy efforts can influence researcher behavior, this influence is contingent on researcher acceptance and empowerment.

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KEYWORDS
Research integrity; questionable research practices; researcher behavior; researcher perceptions; research performing organizations

Introduction

In recent years, numerous policies, guidelines, and initiatives have been launched to address research integrity issues.[1] Such efforts emphasize the importance of good and responsible research practices. They address research misconduct such as Falsification, Fabrication, and Plagiarism (FFP), as well as other detrimental practices that fall in the gray area between FFP and Responsible Conduct of Research (RCR), known as Questionable Research Practices (QRPs). We adopt the definition of QRPs as practices that "violate traditional values of the research enterprise and that may be detrimental to the research process," and which include a diverse set of practices, such as p-hacking, cherry-picking, or lack of validation (Steneck 2006, 59). Although generally not as severe as FFP, QRPs can have serious detrimental effects on the robustness and quality of research and on the academic reward and career system (e.g., issues related to authorship, salami slicing). Research shows that QRPs are widespread across research fields (L. M. Bouter et al. 2016; Fanelli 2009; National Academies of Sciences 2017; Ravn and Sørensen 2021; Schneider et al. 2024). While a meta-analysis of survey results showed that only around 2% of scientists admit to fabricating or falsifying data, a third of researchers acknowledged having engaged in QRPs (Fanelli 2009). A more recent study found even higher rates, with 9 out of 10 respondents admitting to using at least one QRP in relation to recent publications

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(Schneider et al. 2024). However, QRPs are closely tied to distinct research methodologies and therefore also vary in kind and prevalence across fields (Ravn and Sørensen 2021).

To bridge the gap between the abstract principles and concrete research practices, focus has increasingly been directed toward research institutions, who have been called upon to implement organizational research integrity policies (L. Bouter 2024; Mejlgaard et al. 2020). These calls have been met with concrete actions in research funding organizations, some of which now require research organizations to have research integrity procedures in place for their members to be eligible for funding (Horizon Europe 2024). Codes of conduct for research integrity likewise explicitly outline the role of research organizations in upholding standards of research integrity to an increasing degree (ALLEA 2023; NWO 2018). This focus on research organizations has, among other things, sparked a lively debate about how and to what extent these organizations can and should be held accountable for maintaining a climate conducive to research integrity (e.g., de Ridder et al. 2023; Radder 2023).

In this study, we investigate the question of whether organizational research integrity policies are in fact related to QRPs. Given the efforts over the last decade to create research integrity codes of conduct, guidelines, and policies, and the increased focus on organizations' roles in fostering positive change, it is crucial to know if such efforts are reflected in researchers' perceptions and behavior. Specifically, we examine how researchers' perceptions of their organization's research integrity policies relate to their actions. We investigate whether increased *awareness of organisational policies*, *perceptions of their effectiveness*, and *confidence in the organisation's ability to uphold high research integrity standards* positively relate to researchers' behavior, i.e., encouraging more responsible conduct of research and reducing engagement in QRPs.

RQ1: *Do positive perceptions of organizational efforts toward research integrity relate to a lower propensity to engage in questionable research practices?*

Furthermore, we expect that this relationship might be shaped by individual attitudes toward research integrity. Given that prior findings indicate that researchers' attitudes toward research integrity itself relate to questionable research practices (Hofmann and Holm 2019; Hofmann, Thoresen, and Holm 2023; Holm and Hofmann 2018; Mabou Tagne et al. 2020), it is likely that such attitudes are also relevant for how researchers evaluate and react to organizational policies. To test this, we investigate how researchers' attitudes toward research integrity, operationalized as *general attitudes towards research integrity*, *preference regarding organisational research integrity oversight*, and *research integrity self-confidence*, may enable or inhibit the relationship between perceptions of organizational efforts and engagement in questionable research practices.

RQ2: *To which degree is the relationship between organizational perceptions and questionable research practices confounded and/or moderated by individual attitudes toward research integrity?*

To examine our research questions, we employ data from the International Research Integrity Survey (IRIS) developed in the Standard Operating Procedures for Research Integrity project (Allum et al. 2023; Allum, Mejlgaard, and Sorensen 2022). The survey focuses on researchers' experience with and perceptions of research integrity (full questionnaire in Allum, Mejlgaard, and Sorensen 2022). It was distributed to researchers in the EU, UK, Norway, Switzerland, USA, and Canada, with 64,074 respondents. Using this data, we investigate the relationship between researchers' perceptions of their organizations' research integrity efforts and their engagement in QRPs.

The efficacy of research integrity policies

Calling for organizational research integrity policies and guidelines is not new (for an early example, see Nobel 1990). However, in recent years this idea has been refueled by the so-called reproducibility crisis in science (Baker 2016; Ioannidis 2005; Resnik and Shamoo 2017) and wider concerns related to breaches of research integrity (Forsberg et al. 2018; Zwart and Ter Meulen 2019). As a response to this crisis, Begley and Ioannidis (2015), for example, suggest that organizations implement policies on Good Institutional Practices, outlining the organization's policies on training, mentoring, quality standards, data sharing etc. To them, the reproducibility crisis is a multifaceted, multi-stakeholder

problem, but they also point out that organizations have a prime, though not sole, responsibility for addressing it. They and others argue that addressing research integrity issues is a collective responsibility and warn against policies increasing the burden of bureaucracy on researchers without having a positive impact on the quality of the research produced (De Peuter and Conix 2023; Labib et al. 2021).

Despite international efforts to promote the implementation of organizational research integrity policies, knowledge on the efficacy of these initiatives is limited. The effectiveness has only been investigated in a few studies and has seldom been the focal point of investigation. The majority of evidence comes from surveys, e.g., Pryor, Habermann, and Broome (2007), who in a survey of research coordinators' perceptions of scientific misconduct found that "Most research coordinators rated the effectiveness of their institutional policies and procedures in reducing scientific misconduct as high (49.5%) or very high (37.7%) . . . ." However, they also found that the ratings were lower for coordinators, who had experienced or had knowledge about actual cases of research misconduct.

Another example of the potential benefits of research integrity policies comes from Nigeria. In a study of 133 Nigerian medical researchers attending a scientific conference in 2010, Okonta and Rossouw (2013) found that no fewer than 42% of the respondents had committed falsification of data or plagiarism. They also found that falsifying data was related to perceived low effectiveness of one's institution's rules and procedures for reducing misconduct. In the paper, they suggest that the prevalence of misconduct can be reduced by, "Processes such as ethical and scientific review and approval of research protocols, effective monitoring of the research process by the ethics committee, departmental presentations of research work, clear policy on storage of research materials, and policies on punishment" (Okonta and Rossouw 2013, 155).

Fanelli, Costas, and Larivière (2015) also found that research integrity policies and structures can be helpful. Motivated by a desire to better understand factors leading to misconduct and retractions or correction of papers, they collected data on coauthors of all retracted and corrected articles (from Web of Science) from 2010–2011. Regarding the efficacy of research integrity policies, they found that the "likelihood of retraction was lower in countries that have policies and structures to handle allegations of misconduct, particularly when such policies are legally defined or institutional" (Fanelli, Costas, and Larivière 2015, 9). They conclude that "establishing policies and structures to handle allegations of scientific misconduct, promoting transparency and mutual criticism between colleagues, and bolstering training and mentoring of young researchers might best protect the integrity of future science." (14).

In a comprehensive scoping review, Roje et al. (2023) explored the existing knowledge on what facilitates or hinders the implementation of research integrity standards in practice. They did this by mapping the existing landscape of literature on positive and negative factors related to the promotion and implementation of research integrity on three levels: the level of individual researchers, the organizational level, and the system of science. According to Roje et al. (2023), developing, implementing, and updating research integrity policies and guidelines for different research integrity issues are among the factors that can help facilitate the implementation of research integrity standards in practice. On the other side, a lack of clear, detailed and uniform research integrity policies and guidelines are among the factors that are considered to have a negative influence on research integrity standards in practice.

Besides studies like the above-mentioned, qualitative studies indicate that research integrity guidelines can be helpful for researchers in their everyday work, especially if they take disciplinary differences into consideration (Sørensen et al. 2021). Only in this way can policies become relevant and legitimate to researchers. As such, acknowledging variation in methodologies, cultures, and norms across research traditions are key for successful organizational efforts toward promoting research integrity.

In a recent study employing the same data as this study, Brooker and Allum (2024) investigate a series of potential predictors of questionable research practices. Their key finding is that scientific norms (Merton 1979) are related to propensity of engaging in questionable research. They further argue that the explanatory power of organization and country is limited, based on the variance explained by these in multilevel models. They interpret this as a sign that the pressures often connected to questionable research practices (e.g., publish-or-perish), are constant across organizations and countries. For the organizational perceptions which they include, however, they find that awareness of research integrity and positive perceptions of working environment both relate to lower propensity of engaging in questionable research practices.

Attitudes toward research integrity

In our research we are primarily interested in how awareness of research integrity policies, perceptions of their effectiveness, and confidence in the organization's ability to uphold high research integrity standards relate to researchers' behavior. However, researchers' organizational perceptions are intertwined with their broader attitudes toward the concept of research integrity. Researchers' attitudes concerning research integrity matters and their relations to researcher behavior have been the subject of previous research. In particular, studies found that researchers' adherence to high standards of research integrity is correlated by their attitudes, encompassing their views on misconduct, perceptions of the research environment, and certain aspects of self-confidence (Hofmann and Holm 2019; Hofmann, Thoresen, and Holm 2023; Holm and Hofmann 2018; Mabou Tagne et al. 2020). Among doctoral students, positive general attitudes toward the importance of research integrity and a willingness to engage in whistleblowing correlate with lower self-reported misbehavior (Holm and Hofmann 2018).

In addition, several studies have examined the impact of attitudes about the research environment on research behavior, suggesting that scientific misconduct is as much an environmental issue as a matter of personal integrity (Hofmann and Holm 2019; Hofmann, Thoresen, and Holm 2023). Unethical pressure, particularly concerning authorship, is a pervasive problem and often related to higher incidence of research misconduct (Gopalakrishna et al. 2022). Consequently, researchers perceiving their environment as not conducive to high standards of research integrity self-report higher levels of engagement in questionable research practices (Hofmann, Thoresen, and Holm 2023). In our study we will complement these previous findings by analyzing the correlation between attitudes concerning the efficacy of research integrity policies and individual research behavior.

Finally, another stream of literature has examined the relationship between personality characteristics and ethical decision-making in research (Antes et al. 2007, 2016; DuBois et al. 2016). Antes et al. (2007) showed that certain personality traits, particularly narcissism and cynicism, are negatively correlated with ethical decision-making. They also examined the role of the "Big Five" personality traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism) for integrity and found that they had much weaker associations with integrity than cynicism and narcissism, although neuroticism and openness seem to play a minor role for study conduct. Similarly, Schneider et al. (2024) also didn't find any strong relationship between the Big Five and questionable research practices (QRPs). Instead, they found that social factors ("pressure to publish and get funding" as well as "research environment") were much stronger predictors of QRP-prevalence. However, cynicism together with moral disengagement and compliance disagreement are generally associated with lower scores on professional decision-making measures related to research (Antes et al. 2016; DuBois et al. 2016). To enhance ethical decision-making in research contexts, Antes et al. (2016) recommend focusing on reducing moral disengagement while increasing knowledge of responsible conduct of research (RCR).

Methods

To explore the relationship between researchers' perceptions of organizational research integrity efforts and their propensity to engage in questionable research practices (QRPs), we employ the IRIS dataset (Allum et al. 2023; Allum, Mejlgaard, and Sorensen 2022). This dataset is a survey of researchers with at least a master's degree working in the EU27, European Free Trade Area, UK, Canada, Australia, and the USA. Respondents were sampled from an author list of all Web of Science publications published between 2016 and 2020, in which at least one author had an affiliation to one of the included countries. After correcting for potential misspelling, duplicates, etc., this returned a list of approximately 3.2 million researcher profiles with attached e-mail addresses. Out of these, 908,870 researchers were contacted based on response rates in a pretest, out of which 64,074 returned valid responses. Descriptive statistics for all variables described below can be seen in Appendix 1. All code for reproducing results are available at https://github.com/fimonsuglsang/institutionalefficacy-QRPs.

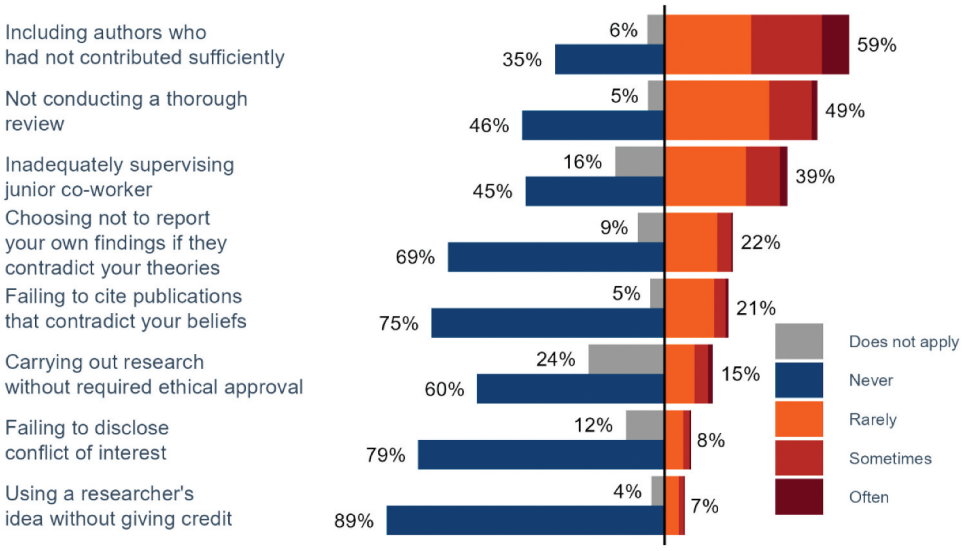

Figure 1. Distribution of self-reported engagement in questionable research practices. Notes: Distribution on the eight included questionable research practices. Percentages indicate proportion saying that a specific questionable research practice either "does not apply," that they "never" engaged in it, or that they engaged in it at any rate in the last three years.

Measuring QRPs

Propensity to engage in QRPs is measured as an additive index based on self-admitted engagement in eight distinct QRPs. The wordings and distributions of these can be seen in Figure 1. Based on both prior work on measuring QRPs as well as extensive qualitative work on cross-disciplinary and cross-methodological understanding of QRPs within the Standard Operating Procedures for Research Integrity project which conducted the IRIS survey, the specific QRPs were chosen for their applicability across research traditions, avoiding methods and field-specific practices. Deliberately employing measures of questionable research practices that are not specific to epistemic domains produces some deviation from typical measurement of QRPs, however this enables the use of a general measure of QRP propensity that applies across all fields of research. Respondents were asked: *"Thinking about research carried out for your publications over the last three years, how often has the following occurred?"* Answer options were "never" (1), "rarely" (2), "sometimes" (3), and "often" (4) with an option to indicate that this *"does not apply in my case."* To produce the QRP measure, the mean score across QRPs was calculated, excluding answers that indicated that the QRP was "not applicable." This score was then standardized to have a mean of zero and a standard deviation of one. Given that this approach produces a highly skewed distribution and does not incorporate variation in occurrence of different QRPs, two additional approaches implementing a count model and a latent variable IRT approach are presented in Appendix 3. Both approaches produce near-identical results indicating robustness of the main results presented below.

Measuring researchers' organizational perceptions

Researcher perceptions of their organization's research integrity efforts are measured as three distinct variables. First, Awareness of Research Integrity Policies. This question asks whether respondents are *"aware of any policies that exist within your organization which address the following research integrity areas?"* across nine policy areas.[2] Second, Evaluations of Effectiveness, measured as the perceptions of organizational effectiveness through the proportion of areas in which participants answered yes rather than no to whether they *"think the policies in your organization are effective as they are"* among policies that they were aware of. Third, the confidence that the respondent has in their organization regarding research integrity, asking, *"how much confidence do you have that the management in your organization is effective in ensuring a high level of research integrity?"* on a 5-point scale ranging from "no confidence" to "complete confidence." All three variables are recoded to have a minimum of 0 and a maximum of 1 for unity across scales, for all variables 1 indicates the highest level of awareness, evaluation, or confidence, whereas 0 indicates the lowest level.

Measuring researchers' research integrity attitudes

To measure research integrity attitudes, we include three variables. First, general research integrity attitude, an additive measure of two 5-point Likert-scaled variables measuring whether the respondent thinks that research integrity policies are "box-ticking exercises" and if they think they improve the quality of their research, both ranging from "never" (1) to "always" (5). Second, preferred RI oversight, i.e., the degree of desired organizational oversight in research integrity matters, a categorical variable ranging from "a lot" (1) to "no" (3) oversight. Third, RI self-confidence, a measure of confidence in the respondent's own research integrity level, ranging from "not" to "very" confident in a three-point ordinal variable. A fourth category containing only 225, and within many countries only single digit or no observations, researchers picking the lowest level of self-confidence (not at all confident) are coded as missing, due to the very low number of observations and the subsequent uncertainty regarding conclusions based on this group.

Demographics

Alongside the focal variables, we include three demographic controls. These measure research field (natural sciences, medical sciences, social sciences, the humanities), career stage (early, mid, senior, retired), and gender of the researcher.

Statistical approach

Analyses are run as OLS regressions controlling for country clustering (implemented using the fixest package; Berge, Krantz, and McDermott 2022, country fixed effects and country clustered standard errors). All results are presented graphically using predicted values (predicted values computed using ggeffects; Lüdecke 2018; and visualizations using ggplot; Wickham 2011). When computing predicted values, controls are set at their mean (continuous), or mode (categoricals) and country is set to the USA. See Appendix 2 for raw regression output and Appendix 3 for robustness checks using alternative codings of QRPs.

Results

Prior to investigating the relationship between researchers' perception of their organizations' research integrity efforts and their engagement in questionable research practices, the baseline levels of engagement in questionable research practices should be noted. As seen in Figure 1 above, there is a clear difference in the self-reported frequency across the included practices. It should also be noted that only 15% of respondents report to have engaged in no QRPs, while most researchers admit to having engaged in one, two or three distinct types of QRPs (with 23%, 24% and 19%, respectively). Respondents admitting to engaging in more than five of the eight types of QRPs are few (3.6%).

The relationships between researchers' organization perceptions and predicted QRP propensity is seen in Figure 2. The figure shows predicted propensity to engage in questionable research practices at the extreme levels of the organization perceptions; awareness of policies, evaluation of these policies, and overall confidence in the researchers' organizations. Control variables are included in four blocks. This blocked approach is chosen as it demonstrates how attitudinal variables may confound the core relationship between organization perceptions and QRP propensity. Model 1 includes awareness of policies, evaluation of these policies, and overall confidence in the researchers' organizations, and control for research field, career stage, and gender. Model 2 adds control for individual research integrity perceptions. Model 3 then adds control for preferences regarding organizational oversight. Model 4 finally adds control for researchers' confidence in their own research integrity.

Across all models, higher awareness of policies, perceived effectiveness of policies, and confidence in organizational RI efforts are associated with lower predicted QRP propensity. Moreover, these relationships are robust to each other given that all three are included simultaneously. Running separate regressions for each of the eight QRPs, see Appendix 4, show that all QRPs are less prevalent among researchers with higher awareness and perceptions of effectiveness. For confidence, however, two of the

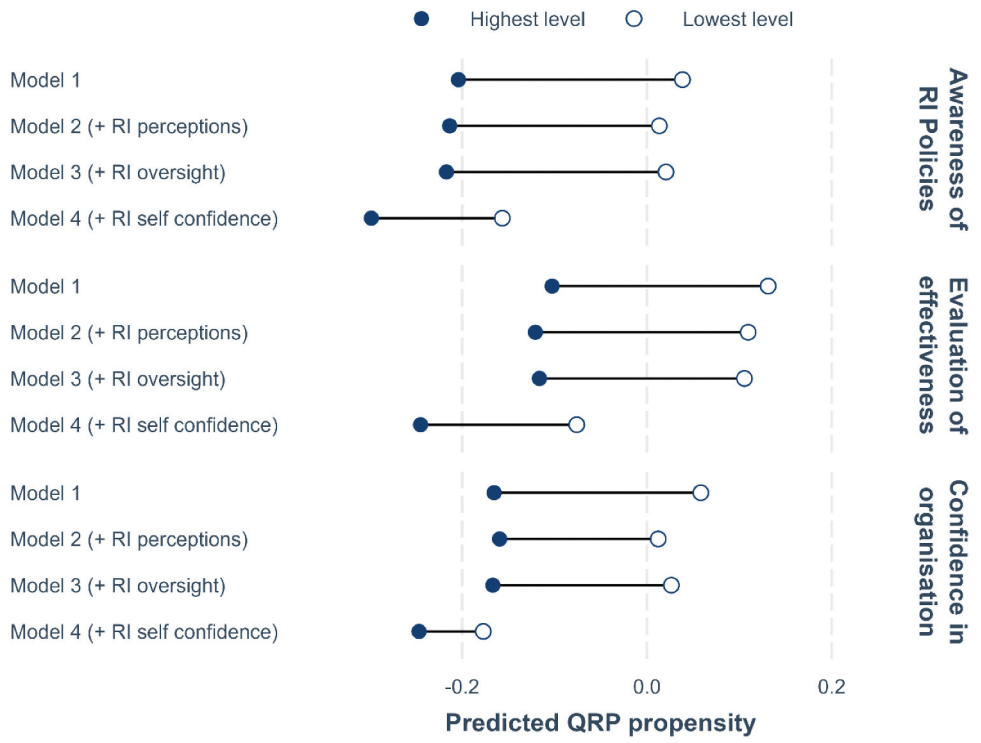

Figure 2. Predicted QRP propensity by researcher organization perceptions. Notes: Predicted propensity to engage in questionable research practices admitted at the highest and lowest levels of researcher organization perceptions. Predictions are computed from OLS regression presented in Appendix 1 Table A4. When computing predictions, controls are set at their mean (continuous) or mode (categoricals) and country is set to the USA. Model 1 includes all organization perceptions, research field, career stage, and gender. Model 2 adds control for individual research integrity perceptions. Model 3 adds control for preferences regarding organizational oversight. Model 4 adds control for researchers' confidence in own research integrity.

QRPs show the opposite direction, specifically the two least frequent QRPs regarding conflict of interest and failing to give credit.

For all three researcher organization perceptions (awareness, evaluation, and confidence), estimates for the relationship between these perceptions and QRP propensity change little when including control for general attitude toward research integrity policies or their attitude toward organizational oversight on research integrity, indicating that these attitudes do not confound the relationship between researcher organization perceptions and engagement in QRPs. However, the estimates change markedly when including RI self-confidence, i.e., controlling for the extent to which respondents feel confident that they themselves adhere to high research integrity standards. This suggests that RI self-confidence plays a considerable part in the relationship between organization perceptions and QRPs. The exact role of self-confidence, i.e., as either a confounder or a mediator, cannot be established based on this observation. However, as seen in Appendix 3 research integrity self-confidence is a strong predictor of QRPs as well as all the three researcher organization perceptions.

To further understand how researchers' organization perceptions and research integrity attitudes interact, a series of moderation models are run. These include all three researcher organization perceptions simultaneously, while controlling for demographics, i.e., identical controls to Model 1 above. Additionally, they include one-way interactions between each researcher organization perception (awareness, evaluation, and confidence) and research integrity attitude (general research integrity attitude, preferred oversight, and research integrity self-confidence) in separate models. Results are presented in Figures 3–5, showing predicted QRP propensity, at the highest and lowest levels of researcher organization perceptions (for full regression outputs, see Appendix 1).

This shows a clear pattern across general research integrity attitudes. For both awareness and confidence, the direction of the relationship between researcher organization perceptions and predicted QRP propensity

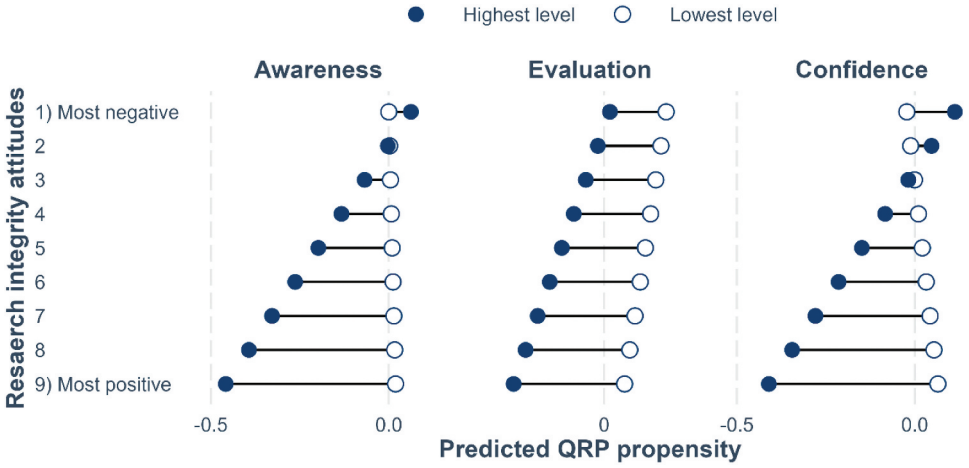

Figure 3. Predicted QRP propensity by researcher organization perceptions moderated by attitudes toward the concept of research integrity. Notes: Predictions computed from OLS regression in Appendix 1 Aable A5. All controls set at their mean (continuous), or mode (categoricals), country set to the USA. All models include all organization perceptions, demographics, and one-way interactions between the indicated organization perception and attitude toward research integrity.

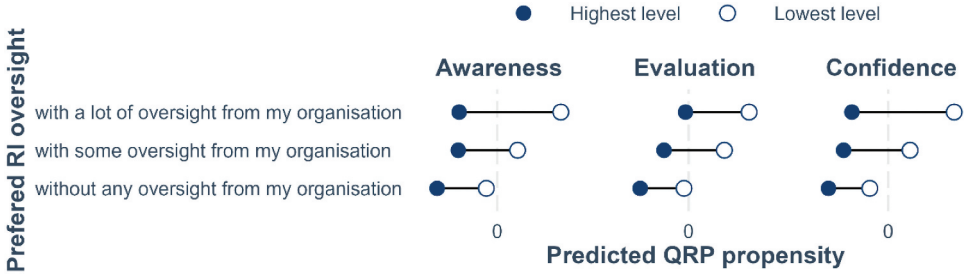

Figure 4. Predicted QRP propensity by researcher organization perceptions moderated by attitudes toward the optimal level of organizational oversight. Notes: Predictions computed from OLS regression in Appendix 1 Table A6. All controls set at their mean (continuous), or mode (categoricals), country set to the USA. All models include all organization perceptions, demographics, and one-way interactions between the indicated organization perception and attitude toward organizational oversight.

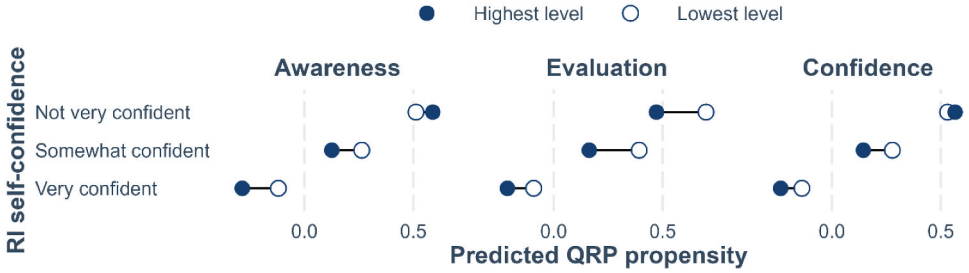

Figure 5. Predicted QRP propensity by researcher organization perceptions moderated by research integrity self-confidence. Notes: Predictions computed from OLS regression in Appendix 1 Table A7. All controls set at their mean (continuous), or mode (categoricals), country set to the USA. All models include all organization perceptions, demographics, and one-way interactions between the indicated organization perception and research integrity self-confidence.

changes dramatically across levels of individual attitudes toward research integrity. Among researchers who are very negative regarding research integrity in general (i.e., perceiving research integrity to be box-ticking exercises and unhelpful to improve research quality) higher policy awareness and organizational confidence are associated with a higher predicted QRP propensity. As respondents' research integrity attitudes turn more positive this reverses and higher levels of policy awareness, perceived effectiveness, and confidence in

the organization are associated with lower predicted QRP propensity. For the evaluation of organizational research integrity policies, however, this pattern is much less pronounced.

Turning to the role of organizational oversight, as seen in Figure 4, across levels of preferred organizational oversight all relationships are in the expected direction, i.e., more positive researcher organization perceptions relate to lower predicted QRP propensities, though for awareness and confidence the magnitude is higher when researchers prefer organizational oversight. As such the association between organizational perceptions and engagement in QRPs is stronger among respondents who report greater openness to oversight.

Finally, as seen in Figure 5, among researchers who are not confident in their own research integrity the relationship between awareness and confidence is reversely, though incredibly weakly, related to QRP propensity, i.e., more confidence and awareness is associated with higher QRP count. As noted above, the exact character of this relationship cannot be established, however it is noteworthy that both negative research integrity attitudes and low self-confidence seem to inhibit or even reverse the positive effects of researcher organization perceptions, strongly indicating that individual perceptions to research integrity are, perhaps unsurprisingly, highly entangled with attitudes toward organizational research integrity measures.

Discussion and conclusion

This study investigated the efficacy of organizational research integrity policies through the lens of researcher perceptions. The study asked first whether researchers' perceptions of their organization's research integrity efforts relate to propensity to engage in questionable research practices. This is clearly the case as awareness of policies, evaluations of policies, and confidence in the organization all independently relate to lower levels of engagement in questionable research practices. Furthermore, we asked whether this relationship is confounded or moderated by individual research integrity attitudes. This is also the case, as particularly research integrity self-confidence confounds and moderates the relationship between researcher organization attitudes and questionable research practices, and attitudes toward the efficacy of research integrity strongly moderate the relationship between researcher organization perceptions and engaging in questionable research practices. As such, while the findings of this study can only show correlations between researchers' perceptions of institutional policies and their own behavior, these two are clearly connected in the minds of researchers.

Though the accuracy of researchers' perceptions of their organization's efforts might be debated, the findings presented above should be grounds for some optimism. More awareness of organizational policies, more positive evaluations of their effectiveness, and more confidence in an organization's ability to uphold high research integrity standards all correlate with lower likelihood to engage in questionable research practices. For research-performing organizations this means that if they have relevant research integrity policies in place, are successful in making researchers aware of these policies, and researchers are confident in their organization's commitment to research integrity, less engagement in QRPs can be expected from their researchers. Our findings thus further support the importance of researchers' perception of the effectiveness of their institutions' rules and procedures for reducing misconduct, as previously pointed out by Okonta and Rossouw (2013). Our findings likewise support Roje et al.'s (2023) general finding that developing, implementing, and updating research integrity policies and guidelines can facilitate the implementation of research integrity standards in practice. However, it is important to emphasize that our results indicate that the implementation must focus both on making researchers aware of these standards and convincing them of the institution's commitment to research integrity. While addressing a somewhat different set of QRPs, our findings also align with studies among (former) doctoral researchers at university medical centers, showing a correlation between researchers' personal attitudes toward research integrity and their perceptions of the research environment displaying high levels of integrity (Hofmann, Thoresen, and Holm 2023).

While optimism regarding the role of organizational initiatives is warranted, these results should not be the grounds for expecting miracles and assessing the magnitude of the impact that may be associated with changing researchers' organization perceptions is not an easy task. A skeptic reading might indeed suggest a rather modest potential of institutional initiatives. Awareness and evaluation of policies alongside organizational confidence all independently relate to lower QRP propensity,

however, the mean difference between the extreme institutional perceptions is around ~0.2 standard deviations for each of the three perceptions. While this is a significant difference, particularly if all three are achieved simultaneously, we lack knowledge on the degree to which researchers' perceptions are sensitive to organizations' actual practice, and subsequently how much of the relationship uncovered above they can realistically harness. As such, further work incorporating the institutional efforts directly is needed to complement existing studies. Looking to studies in other contexts, e.g., on harassment or gender equality policies in academia, findings indicate that policy initiatives on their own are not very likely to be effective. Such initiatives must be coupled with further organizational efforts to make a difference (Timmers, Willemsen, and Tijdens 2010; Winchester and Browning 2015).

The relationship we find is not merely the product of attitudes toward the concept of research integrity, which was the main object of previous studies, nor preferred levels of organizational oversight. However, research integrity self-confidence clearly plays a role in the relationship between researchers' organizational perceptions and their engagement in questionable research practices. Whether this is an indication that self-confidence is produced by researchers' organizational perceptions (i.e., mediation) or whether it is an indication that it confounds the main relationship cannot be established by this data but require additional experimental and/or longitudinal investigation. However, the entanglement of organizational and individual researcher integrity perceptions should be noted.

The entanglement between individual and organizational perceptions is further underscored by the interactions between researchers' organizational perceptions (awareness, evaluation, and confidence) and attitudes toward research integrity. Notably, a positive attitude toward research integrity seems to be a prerequisite for researchers' organizational perceptions to have the expected relationship to QRP propensity. In fact, when researchers have a negative perception of research integrity, the relationship between awareness and confidence and engagement in questionable research practices is reversed. The same pattern, though less dramatically, is apparent regarding research integrity self-confidence which reiterates the role of this factor in shaping researcher behavior. This also aligns with previous findings on the effectiveness of policy initiatives in other contexts, indicating that such initiatives and awareness of them are not likely to be effective without efforts to change attitudes among those that are to be regulated (see, e.g., Winchester and Browning 2015).

The nature of the data employed in the analyses above come with a series of limitations for the findings of the study. As noted above, we are only able to identify relationships between variables and not causal effects. This is especially pressing regarding the direction of the relationships between the three key concepts of researcher organization perceptions, research integrity attitudes, and propensity to engage in questionable research practices. While the theoretical assumption is that organizations can change researcher behavior through convincing researchers of their commitment to research integrity, we cannot say with certainty that perceptions of organizations, as well as attitudes toward research integrity attitudes, are not themselves reflections of past behavior. Adding to this uncertainty, researchers' knowledge of their organizations' policies is surely imperfect, and as such, while the organization perceptions at the center of the analyses above do reflect what researchers think, it is less certain that it reflects what organizations do. Moreover, the list of QRPs included in this study contains only eight forms of questionable research practices and omits some very common practices for broader applicability (e.g., p-hacking, HARKing). As such the outcome variable in the analyses presented above contains a specific version of the concept. This broad approach, including the wide-reaching disciplinary and geographic breadth, does provide a larger coverage but also means that nuances related to specific traditions may be lost.

However, the study clearly shows that the awareness and confidence that researchers have relate to their research behavior. These findings add additional insights to previous findings by Antes et al. (2016), who found a positive relationship between knowledge of rules and principles of responsible conduct of research (RCR) and professional decision-making in research – and they emphasize the importance of efficient training and awareness building. It might further be asked what it is that makes researchers' organizational perceptions relate to their engagement in questionable research practices. Is it that they fear punishment if they transgress – as Okonta and Rossouw (2013) suggest in relation to falsification of data and plagiarism – or are they simply convinced of the benefits of good research practice? This cannot be clearly established by the above, but the role of general attitudes toward research integrity might indicate that only through

convincing researchers of the value of research integrity can policies be fruitful. Finally, the causal direction of the relationship between researchers' organization perceptions and questionable research practices cannot be established here and the relationship is likely bi-directional. That is, while organizational research integrity efforts likely do shape researcher behavior through their perceptions of these efforts, it is also likely that the way researchers perceive their organizations, and research integrity as such, is also shaped by their own behavior.

The relationship between research integrity policies, perceptions of such efforts, attitudes toward research integrity, and researcher behavior is complex. While this study undoubtedly simplifies this complexity, it should be clear that none of these can stand alone. If research-performing organizations want to motivate researchers to adhere to high standards of research, policies and training alone are insufficient. They must also convince researchers that both policies and the organizations themselves are effective. Moreover, the individual researcher's confidence in their own ability to live up to research integrity principles plays a pivotal role in this process, as do their attitude toward the efficacy of research integrity initiatives. As such, this study highlights that the policies implemented by research organizations, to the degree that these are received by researchers, can foster research integrity only when researchers believe in the cause and feel empowered to perform high integrity research.

Notes

1. These include codes of conduct such as the European Code of Conduct for Research Integrity (ALLEA 2023), the World Health Organizations' Code of Conduct for Responsible Research (2017), national codes like The Danish Code of Conduct for Research Integrity (2014) and the Netherlands Code of Conduct for Research Integrity (2018), as well as statements from the World Conference on Research Integrity (WCRI), including the Singapore Statement on Research Integrity (2010) and the Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations (2013).
2. These policies areas were chosen based on extensive qualitative work as a part of the Standard Operating Procedures for Research Integrity project, in which the design and fielding of the IRIS survey was done. The specific policy areas are: 1) Working Environment, 2) Supervision and Mentoring, 3) Integrity Training, 4) Ethics Structures, 5) Integrity Breaches, 6) Data Management, 7) Research Collaboration, 8) Declaration of Interests, and 9) Publication and Communication.

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Author contributions

CRediT: **Simon Fuglsang:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing; **Serge P.J.M. Horbach:** Conceptualization, Writing – original draft, Writing – review & editing; **Mads P. Sørensen:** Conceptualization, Writing – original draft, Writing – review & editing; **Niels Mejlgaard:** Conceptualization, Writing – review & editing.

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