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Biomedical Authors' awareness of publication ethics: An international survey

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Abstract

Objective

The extent to which biomedical authors have received training in publication ethics, and their attitudes and beliefs about the ethical aspects of specific behaviours, have been under-studied. We sought to characterise the knowledge and attitudes of biomedical authors about common issues in publication ethics.

Design

Cross-sectional online survey.

Setting and participants

Corresponding authors of research submissions to 20 journals.

Main Outcome Measure(s)

Perceived level of unethical behaviour (rated 0 to 10) presented in five vignettes containing key variables that were experimentally manipulated on entry to the survey and perceived level of knowledge of seven ethical topics related to publishing (prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism).

Results

4043/10,582 (38%) researchers responded. Respondents worked in 100 countries and reported varying levels of publishing experience. 67% (n=2700) had received some ethical training from a mentor, 41% (n=1677) a partial course, 28% (n=1130) a full course, and 55% (n=2206) an online course; only a small proportion rated training as excellent. There was a full 0 to 10-point range in ratings of the extent of unethical behaviour within each vignette, illustrating a broad range of opinion about the ethical acceptability of the behaviours evaluated, but these opinions were little altered by the context in which it occurred. Participants reported substantial variability in their perception of their own knowledge of ethical topics; one-third perceived their knowledge to be less than "some knowledge" for the sum of the seven ethical topics and only 9% perceived "substantial knowledge" of all topics.

Conclusions

We found a large degree of variability in espoused training and perceived knowledge, and variability in views about how ethical or unethical scenarios were. Ethical standards need to be better articulated and taught to improve consistency of training across institutions and countries.

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Strengths and limitations of this study:

- Large survey providing a snapshot of author's awareness of publication ethics at a single point in time
- Included authors from a range of journals, disciplines, countries and with varying levels of research and publishing experience
- Responses were based on short hypothetical vignettes rather than personal experience

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Introduction

Many biomedical scientists report substantial pressure to produce numerous research publications, in part because the number of papers published is the main metric in most academic promotion systems. [1] In some cases, this pressure to publish may lead to ethical lapses, such as plagiarism, self-plagiarism (text recycling), ghost or honorary authorship, or failure to report competing interests. [2-5]

The increasing pressure to publish has not been matched with widespread training for researchers about ethical matters that are commonly encountered in the process of scientific publication. The Committee on Publication Ethics (COPE) provides such training for biomedical editors, but similar opportunities for researchers appear to be uncommon. [6] As with peer review, it may be assumed that researchers already have this knowledge or will learn on the job from mentors.

Previous research has identified considerable variation in knowledge and attitudes about publication ethics among biomedical scientists. For example, in one survey of 324 post-doctoral fellows a substantial proportion of respondents thought that being "head of the lab" or obtaining study funding were enough to qualify as an author on publications. [7] Around 20% of respondents reported that they had been unfairly omitted as an author. 38% of those who had been authors on previous publications reported that a co-author had not met authorship requirements.

Another study aimed to characterise professional norms regarding publication ethics among US grant-receiving scientists and research administrators. [8] This large study used a factorial vignette design. Virtually all respondents thought that fabrication, falsification, and plagiarism were unethical, but there was poor consensus regarding other behaviours such as making deliberately misleading statements about a paper, sloppiness, or failure to report conflicts of interest. Some research suggests that views about publication ethics may vary based on culture or scientific discipline. [9-11]

The goal of this study was to evaluate the prevalence and quality of formal training in publication ethics among biomedical authors, and to elicit their attitudes and beliefs about specific behaviours. We aimed to study a large group of authors from diverse specialties and geographic locations. We also sought to determine whether views differed depending on level of research experience, location of training or practice, or specific mitigating or aggravating contextual circumstances that might be expected to alter perceptions about the seriousness of ethical lapses.

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Methods

Sample

In 2010, we surveyed corresponding authors of research submissions to 20 biomedical journals in a range of specialties published by The BMJ Publishing Group. The participating journals vary in terms of volume of research received, Impact Factor and acceptance rates. Contact information and other details of authors were obtained from the electronic manuscript tracking systems of each journal. All corresponding authors of research paper submissions in 2009 were eligible for inclusion in the study. We removed duplicate authors to ensure each author was invited only once.

Procedures

Eligible authors were sent a personalised invitation to complete a survey regarding publication issues on an independent secure website. As an incentive to participate, respondents were entered into a prize draw to win a donation of £500 to a choice of charities. Authors were informed that responses would be confidential and that editors would not see named individual responses. Two reminders to complete the survey were sent to non-responders at approximately two weeks and two months after the initial mailing.

Questionnaire development and piloting

Questionnaire content and vignettes were developed from discussion with experts in publication ethics, and based on ethical problems encountered by BMJ editors and other members of the research team. The questionnaire was administered to four experts in publication ethics and two experts in survey design to confirm content validity and to check for ambiguous questions. It was then piloted with convenience samples of students and editorial assistants. We ran two further pilots (with 45 members of the editorial board of *Anesthesiology* and a sample of 100 submitting authors) to estimate response rate and burden. The questionnaire was shortened based on these results.

Survey instrument

The questionnaire assessed the level of awareness of good publication practices. It had three sections: 1) vignettes describing a situation on a range of topics (prior publication, exclusion of an author, self-plagiarism, honorary authorship, and undeclared conflicts of interest); 2) questions about the respondent's perceived level of knowledge of seven ethical topics; and 3) questions about respondent characteristics.

Vignettes

Respondents were shown a series of five vignettes. Each vignette was a short paragraph describing an ethical scenario (prior publication, author omission, self-plagiarism, honorary authorship, and undeclared conflicts of interest). There were several permutations of each vignette to determine the importance of mitigating or aggravating factors on perceptions of the seriousness of ethical lapses. Specifically, within each vignette there were three variables, each with two possible statements. For example, within the vignette about self-plagiarism,

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respondents were randomised to rate a vignette that described a more or less experienced corresponding author, the presence or absence of a journal policy prohibiting self-plagiarism, and the type of previous publication of the plagiarised material (conference proceedings or abstract at a meeting). Participants were randomised to receive different combinations of possible statements for each vignette. They were asked to rate how unethical they thought the researcher's behaviour was on a numerical rating scale (0=Not at all unethical, 10=Extremely unethical), similar to that used in a previous study. [8] With the exception of the prior publication vignette, which described a situation that was not considered unethical and was always presented first, the vignettes were selected and presented at random on entry to the survey. Each vignette was presented on its own page and respondents were not allowed to return to a vignette and change their ratings after moving to the next page. Box 1 shows the five vignettes and the statements randomised within each.

Perceived knowledge

Respondents were given a short definition of seven ethical topics and asked to indicate their level of knowledge (no knowledge, some knowledge, substantial knowledge) of each topic: prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism.

Respondent characteristics

Participants were asked their gender, age, work specialty, country of work, country of training, number of years spent as an active researcher, number of research papers published, number of articles they peer review each year, whether they had performed editorial roles, and to rate the quality of the training or guidance they had received on the ethics of undertaking and publishing scientific research.

Statistical analysis

TH conducted all statistical analyses and was blinded to the identities of the respondents. Prior to the analysis the data were inspected for completeness and accuracy. Missing data were examined based on participant and response characteristics. All available data were used for the analysis. Descriptive statistics were reported based on the nature of the underlying data: medians [25th, 75th percentile] are used for data with interval properties and frequency counts (%) are used for categorical data.

We compared respondents with non-respondents by country in which they were based, the journal to which they submitted, and whether they received an acceptance or rejection from that journal. Perceived knowledge scores were transformed into a T score (mean: 10, SD: 10). Correlations between items were estimated using Kendall's Tau correlation to account for ties in the ordinal scales. The primary analysis was conducted for each vignette using several generalised linear models with perceived 'unethicalness' as the outcome variable and randomised condition as the predictors. For the model, the three main effects for each condition were entered along with all two-way interactions and a three-way interaction. Higher order interactions were interpreted such that combinations of the randomised conditions induced differences in unethicalness scores that were

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conditional on the levels of the other conditions. We did not adjust for multiple comparisons. Where appropriate, all analyses are two-tailed and statistical significance is inferred for $p < 0.05$. R statistical software (R Core Team, 2012) was used for all analyses. [12]

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Results

Respondent characteristics

Figure 1 displays the disposition of the available email addresses, problems encountered while soliciting responses, and the final sample of respondents. After correcting for bounce-backs, 10,582 people were sent an invitation of whom 4043 (38%) visited the website. Of these individuals, 3668 (91%) rated at least one vignette and 3090 (76.1%) completed all survey items. Having an article triaged (33.7% response rate) versus actually reviewed (34.5%) was not related to the response rate, p = 0.339, nor were submitting a rebuttal to the decision, the time to decision, or the type of submitted article.

Figure 2 displays the number of responses received based on country of work for the top 20 contributing countries. Of the countries that had greater than n=100 individuals who were sent surveys, the likelihood of surveys being returned varied widely between countries. For example, 53/102 (51.9%) of individuals from New Zealand returned surveys, while only 34/194 (17.5%) of individuals from Korea returned surveys. The three countries with the highest response rates were New Zealand (51.9%), Norway (45.9%), and Sweden (44.5%). The three countries with the lowest response rates were Korea (17.5%), unreported country (26.0%), and Finland (26.8%).

Respondents had a median [25th, 7th] age of 44 [37, 52] and about 30% were female (Table 1). Roughly 17% of the 3,222 respondents who disclosed their country of training and country of work reported that they received postgraduate education in a country that was different to their current country of work. The modal respondent had 9 to 15 years of research experience, with 23% reporting more than 20 years of research experience. The modal respondent completed 2 to 4 peer reviews each year (median: 5 [2 to 10]) and had published a median of 30 [10, 70] articles in their career. 1073 (26.5%) of the respondents reported serving on at least one journal editorial board.

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Training in Publication Ethics

Training from a mentor was the highest rated source, with 43% of the sample reporting perceiving at least a "good" or "excellent" level of training from a research mentor (Table 2). Formal training was less common, with 51% of respondents reporting they have never participated in a full course on publication ethics, and less than half (42%) reporting receipt of some ethical training in partial coursework. The most commonly reported source of training was online courses, with 55% of the sample reporting this type of experience, but only 31% rated the quality of this online training as "good" or "excellent".

Previous training was positively associated with perceived knowledge scores, indicating that individuals with higher levels of previous training endorsed higher perceptions of knowledge about ethical issues. To estimate this association, we coded each respondent's highest rating from any of their previous training sources, and estimated an association with their perceived knowledge total score. The correlation was phi = 0.45 ($p < 0.001$).

Perceived Knowledge of Publication Ethics

Participants reported substantial variability in the perception of their own knowledge about seven ethical topics (Table 3). The majority of participants reported that they had "some knowledge" of most issues (37.2% to 59.9% across the seven domains), yet 37.6% also reported no knowledge on issues related to omitted authors. Participants' scores on each of the seven domains of perceived knowledge were only moderately correlated ($r = 0.21$ to 0.50, p's < 0.001; Table 3). The individual items were summed to create a total score, which demonstrated good internal consistency ($\alpha = 0.84$ and item-total correlations <0.30). Perceived knowledge on one domain was a good predictor of how a participant perceived their overall knowledge of these issues. One-third (33.7%) of the participants perceived their knowledge to be less than "some knowledge" for the sum of the seven listed ethical topics. Only 8.8% of participants espoused a belief that they possessed "substantial knowledge" on all seven topics.

Vignettes

Figure 3 displays the unethical ratings for each vignette as a function of the experimental manipulations. The degree of variability in the ratings can be seen in each vignette, with the entire range of possible responses (0 to 10) present for each of the scenarios. Responses for each vignette are presented below.

Prior publication

For this vignette, the experimental manipulations accounted for a statistically significant ($p < 0.0001$), though only small amount (6.4%), of the total variability in responses, leaving 93.6% of the variation in responses unaccounted for by any of the manipulated factors. There were no higher-order interactions among the experimental manipulations, allowing main effects to be interpreted.

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The experience of the researcher was not a factor in influencing responses, with distinctions between senior and junior researchers accounting for only 0.006 points on the 10-point unethical scale (95%CI: -0.21 to 0.22, p = 0.959). If the journal had a policy about previous publication, the behaviour described in the vignette was rated as 0.38 points (95%CI: 0.16 to 0.60, p = 0.0006) more unethical than if the journal did not possess a policy. If the previous submission was published in proceedings from a conference, the behaviour was rated as 1.68 points (95%CI: 1.46 to 1.89, p < 0.0001) more unethical than if it were only previously reported as an abstract.

Author omission

The experimental manipulations accounted for only 16% of the total variability in responses (p < 0.0001) leaving 84% of the variation in responses unaccounted for by any of the manipulated factors. The order in which this vignette was presented to respondents influenced ethical ratings of the behaviour it described. Respondents who viewed the vignette later rated the behaviour it described as -0.18 points less unethical for each previous vignette encountered. There were no higher-order interactions among the experimental manipulations, allowing main effects to be interpreted.

The experience of the researcher did not influence responses, with distinctions between senior and junior researchers accounting for only 0.036 points on a 10-point unethical scale (95%CI: -0.16 to 0.23, p = 0.717). The time elapsed since contact was lost with the author influenced ratings of the vignettes with 6 months elapsed rated as -0.64 points (95%CI: -0.84 to -0.45., p < 0.0001) less unethical than if only 1 month had elapsed. If the missing author was formally acknowledged, the practice was rated as - 2.45 points (95%CI: -2.64 to -2.26, p < 0.0001) less unethical than if they were not acknowledged.

Self-plagiarism

The experimental manipulations accounted for only 1.5% of the total variability in responses (p < 0.0001), leaving 98.5% of the variation in responses unaccounted for by any of the manipulated factors. The order in which the vignette was presented did not influence ratings (p = 0.71). There were no higher-order interactions among the experimental manipulations, allowing main effects to be interpreted.

The experience of the researcher did not influence responses, with distinctions between senior and junior researchers accounting for only 0.17 points on a 10-point unethical scale (95%CI: -0.02 to 0.36, p = 0.072). The quantity of self-plagiarised material did influence ratings of the behaviour described in the vignette, with 35% of the material being plagiarised rated as 0.61 points (95%CI: 0.42 to 0.80, p < 0.0001) more unethical than if only 10% had been plagiarised. If the plagiarised sections included the literature interpretation, the practice was rated as 0.30 points (95%CI: 0.11 to 0.49, p = 0.002) more unethical than if only the literature search strategy was plagiarised.

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Honorary authorship

The experimental manipulations accounted for only 8.2% of the total variability in responses ($p < 0.0001$) leaving 91.8% of the variation in responses unaccounted for by any of the manipulated factors. The randomised order in which this vignette was presented to respondents did influence ethical ratings of the behaviour it described. Those who viewed the vignette later rated behaviour as -0.14 points less unethical for each previous vignette encountered. There were no higher-order interactions among the experimental manipulations, allowing main effects to be interpreted.

The experience of the researcher did not influence responses, with distinctions between senior and junior researchers accounting for only 0.11 points on a 10-point unethical scale (95%CI: -0.08 to 0.30, $p = 0.08$). However, the seniority of the added author did influence ratings, with added junior authors (submitting their first paper) rated as 0.64 points (95%CI: 0.45 to 0.82, $p < 0.0001$) more unethical than added senior professors (heads of department). If the contribution of the added author included a careful reading of the manuscript (e.g. correcting typographical errors) as well as advice, the practice was rated as -1.51 points (95%CI: -1.70 to -1.32, $p < 0.0001$) less unethical than if only general advice was offered without a careful reading of the manuscript.

Conflicts of interest

The experimental manipulations accounted for only 4.2% of the total variability in responses ($p < 0.0001$) leaving 95.8% of the variation in responses unaccounted for by any of the manipulated factors. The randomised order in which this vignette was presented to respondents affected ethical ratings, with later viewings rating the described behaviour as 0.19 points more unethical for each previous vignette encountered. There were no higher-order interactions among the experimental manipulations, allowing main effects to be interpreted.

The experience of the researcher did influence responses, with distinctions between senior and junior researchers accounting for -0.28 points on a 10-point unethical scale (95%CI: -0.45 to -0.12, $p = 0.0006$). The duration elapsed since the conflict of interest influenced ratings of the vignettes; 3 years since the conflict was rated as -0.35 points (95%CI: -0.52 to -0.19, $p < 0.0001$) less unethical than if the conflict was more recent (1 year). If the conflict of interest consisted of receiving speaking fees, the practice was rated as -0.93 points (95%CI: -1.10 to -0.77, $p < 0.0001$) less unethical than if a research grant was involved.

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Discussion

Only a small minority of biomedical researchers reported a substantial level of knowledge about the ethical matters evaluated in this study. Most had not had a full course of formal training in publication ethics. Instead, informal training from mentors, who themselves possibly had not received formal training, was common. Our results are consistent with studies done several decades ago that found low levels of training in research ethics among graduate students and postdoctoral fellows. Three studies in the 1990s reported low levels of training or guidance in research ethics among students from the US. [7, 12-14]

Although individual respondents clearly distinguish among publication practices that are more or less ethical, there is a striking lack of consensus on many matters, especially self-plagiarism and inappropriate authorship. Prior work suggests that opinions on these two topics vary considerably. [15, 16] The lack of agreement about the seriousness of the topics presented might reflect either unreliability of the assessment paradigm or true disagreement among respondents regarding the behaviour that is described. Since most respondents did not receive what they considered to be good ethical training, the latter seems most likely. In the absence of formal, standardised training in publication ethics, respondents presumably relied on their own experience and beliefs to determine whether and to what extent something was unethical.

In a previous study, conflicts of interest were condemned most strongly when there was failure to disclose a financial interest, and deliberate plagiarism was judged more harshly than when it was unintentional. [8] We thus tested several versions of each of our vignettes to see whether there were specific circumstances that altered judgments about the ethical appropriateness of each behaviour. For example, junior faculty report that they feel an obligation to add guest authors to papers if that person is an administrative superior. [17] It seemed reasonable to expect that being a junior rather than a senior researcher might cause respondents to view an ethical lapse as less serious. To our surprise, however, this was not the case, a finding that replicates previous work showing that sex and academic seniority of a scientist did not affect malfeasance ratings. [8]

This was also true for the other altered variables. More than 84% of the variance in ethical ratings was unrelated to the experimental manipulations within the vignettes; these accounted for only 1.5% to 15% of the variance in ethical ratings. This suggests that although there is a broad range of opinion about the ethical acceptability of the behaviours we evaluated, these opinions are little altered by the context in which it occurs. In other words, at least among our sample of active biomedical researchers, respondents appear to judge certain behaviours to be intrinsically ethical or not.

Strengths and limitations

Our study has a number of strengths. It is the largest survey of its kind, with over 3000 responses from active researchers submitting research papers to a range of peer-reviewed specialty journals and a general medical journal. We included authors who had received both rejection and acceptance decisions so that the sample

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would be representative of researchers in general, not just those who succeeded in publishing in the selected journals. The survey also includes responses from researchers who have worked and trained in a large number of countries and institutions. This is in contrast to previous surveys that have been smaller or have focused on a single country, discipline or institution. [7, 8, 13, 14]

Our study also has a number of limitations. The response rate of 31% is low. It is possible that the complexity of the survey or the sensitive nature of the topic discouraged some participants. It is also possible that institutional spam filters prevented our emails from reaching respondents. However, physician responses to web surveys are known to be declining and the response rate to our survey is similar to that reported in a large survey of doctors. [18] Additionally, the response rate to this survey is in the same range as other surveys on this sensitive topic, which have ranged from 27 to 33%. [7, 14, 19]

Although we observed some order effects, these were small and the randomised order of vignette presentation makes it unlikely this has produced any bias in our results. The journals in our study are all published by the BMJ Publishing Group and are relatively high profile journals with a strong commitment to ethical standards. At the time of the survey, many of these journals provided guidance about matters of publication ethics on their website or during the submission process. This might have affected author awareness and views about some of the behaviours that we studied. Thus, our results may not be generalisable to authors submitting to other journals.

Study Implications

Our study of a diverse group of biomedical researchers shows that the prevalence of formal training in publication ethics is low, and when training is received it is often perceived to be of low quality. Although it is tempting to suggest that efforts are needed to improve the availability of formal training in publication ethics, such action may be premature. There is a surprising lack of consensus among researchers about the ethical seriousness of behaviours that many experts consider to be inappropriate, although even experts do not always agree. [20]

Readily available, standardised training might help, but first we need to understand the reasons for these divergent views to design effective instruction. Once this is done, a strong case can be made that educational efforts should begin with medical journal editors and senior researchers, rather than those who are more junior. The rapid growth of the Committee of Publication Ethics (COPE) from a handful of editors fifteen years ago to a current membership of thousands illustrates the desire of editors for guidance on ethical matters. Both COPE and the World Association of Medical Editors (WAME) provide online guidance intended principally for journal editors and publishers. Despite this, even editors of major medical journals, the majority of whom report having had training about editorial responsibilities, have shown poor knowledge of many ethical matters that are commonly encountered in scientific publishing. [21]

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Perhaps because of this deficient training and knowledge among editors, medical journals do not always have policies or provide clear or consistent ethical guidance to authors. [22] Some journals have policies based on guidance from COPE but have developed their own standards regarding specific matters such as authorship. [23] Amongst those titles with policies, there are frequently differences in the interpretation and execution of ethical standards. [24]

Perhaps the most practical starting point would be to work harder to identify core ethical matters about which there is little disagreement, while leaving individual journals to develop and impose their own standards about things for which there is less consensus. The biomedical community has a responsibility to articulate and enforce standards of publication ethics in order to maintain public trust in research.

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Competing interests

SS is a full-time employee of the BMJ Publishing Group and has access to all submission data and regularly undertakes research with its authors and reviewers. SM is a former employee of BMJ Publishing Group. EL receives salary support from *The BMJ* for her services as head of research. This is paid to her employing institution (the Brigham and Women's Physician Organization). TH, JR, DP have no relevant conflicts of interest.

Funding

We received a £5,000 research grant from the Committee on Publication Ethics to conduct the study.

Ethics

We submitted our research proposal to the BMJ Ethics Committee for comment. They did not have any specific ethical concerns about the study design. The research committee of the Committee on Publication Ethics (COPE), which funded the study, also approved the study protocol. Editors of participating journals gave their consent for the study.

Contributorship

All authors (SS, JR, EL, DP, SM, TH) contributed to the design of the study and the survey tool, were involved in regular steering group meetings, and critically reviewed the manuscript and approved the final version before submission. SS, TH and JR wrote the first draft of this manuscript. EL revised the manuscript and reference list and solicited comments from other authors. JR took the lead on reviewing the literature. SS and SM gathered the sample of authors. SS piloted the survey with students and experts. Chadwick de Voss developed the survey software, signed a confidentiality agreement for the BMJ and managed the electronic database. SS managed email responses and bounce backs to the survey. TH conducted all statistical analysis and was blinded to the respondents' identities and signed a confidentiality statement for the BMJ. All authors (SS, JR, EL, DP, SM, TH) helped interpret the findings and approved the final version of the manuscript for publication.

Data Sharing Statement

Data are available upon reasonable request.

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Table 1: Respondent characteristics

Characteristic	Respondents visiting site (4,043) n (%) median [25th, 75th]	Missing/Not Reported n (%)
Age (years)	44 [37, 52]	829 (20.5%)
Sex		811 (20.1%)
Male	2030 (50.2%)	
Female	1202 (29.7%)	
Previous experience in an editorial role?		802 (19.8%)
No	2168 (53.6%)	
Yes	1073 (26.5%)	
First (main language)		878 (21.7%)
English	1250 (30.9%)	
Other	1915 (47.4%)	
Years of research experience		878 (21.7%)
1 to 2 years	148 (3.6%)†	
3 to 5 years	106 (2.6%)	
6 to 10 years	587 (14.5%)	
11 to 15 years	802 (19.8%)	
16 to 20 years	591 (14.6%)	
21 to 25 years	421 (10.4%)	
26 to 30 years	298 (7.4%)	
> 30 years	212 (5.2%)	
Number of peer reviews conducted annually	5 [2, 10]	785 (19.4%)
Number of papers published	30 [10, 70]	772 (19.1%)

Note: Not all percentages sum to 100% due to rounding.

† Due to a computer coding mistake, this value was stored with missing values and was imputed using deterministic methods (i.e., the value was deduced by examining the other responses).

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Table 2: Receipt and quality of ethical training (n=4043)

Type of training/guidance	Not received	Poor quality	Average quality	Good quality	Excellent quality	Missing data
Ethical training from a mentor	535 (13.2)	232 (5.7)	718 (17.8)	1146 (28.3)	604 (14.9)	808 (19.9)
Ethical guidance: partial course	1526 (37.7)	156 (3.9)	566 (14.0)	766 (18.9)	189 (4.7)	840 (20.8)
Ethical guidance: full course	2053 (50.7)	117 (2.9)	332 (8.2)	487 (12.0)	194 (4.8)	860 (21.2)
Ethical guidance: self training through online resources	989 (24.5)	164 (4.1)	796 (19.7)	1007 (24.9)	239 (5.9)	848 (21.0)

Note: Percentages do not sum to 100% due to rounding.

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Table 3: Respondents self-perceived level of knowledge of seven publication ethics topics

Topic	Number completing each question	Perceived knowledge n (%)*			Kendall's Tau correlation						
		None	Some	Substantial	PP	AO	SP	HA	CI	IM	P
Prior publication (PP)	3360	489 (14.6)	1886 (56.1)	985 (29.3)	-						
Author omission (AO)	3363	1265 (37.6)	1380 (41.0)	718 (21.3)	0.36	-					
Self-plagiarism (SP)	3362	227 (6.8)	1409 (41.9)	1726 (51.3)	0.49	0.31	-				
Honorary authorship (HA)	3361	283 (8.4)	2014 (59.9)	1064 (31.7)	0.45	0.36	0.40	-			
Conflicts of interest (CI)	3361	77 (2.3)	1251 (37.2)	2033 (60.5)	0.33	0.21	0.40	0.40	-		
Image manipulation (IM)	3362	125 (3.7)	1456 (43.3)	1781 (53.0)	0.38	0.28	0.48	0.41	0.46	-	
Plagiarism (P)	3364	512 (15.2)	1268 (37.7)	1584 (47.1)	0.45	0.38	0.50	0.43	0.38	0.45	-

* Reported as a proportion of the number who completed each item.

All correlations $p < 0.0001$.

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Box 1: List of variables randomised within each vignette

Topic	Vignette	Variable for randomisation	Statements varied
Prior publication	A [experience] researcher submitted a manuscript describing the primary results of a study to a medical journal that [journal policy]. A peer reviewer comments that the same study results have already been published [How the study had previously been reported] and that this prior publication means the work is not new and should not be considered for publication by the journal.	Experience	• senior experienced • junior inexperienced
		Journal policy	• prohibits the submission of work that has previously been published • has no policy regarding the submission of work that has previously been published
		Previous reporting of study	• in an abstract at a professional meeting • as a paper in the proceedings from a conference
Authorship omission	A corresponding author, a [experience] member of staff, is ready to submit a manuscript. A research student, helped with the design of the study, data collection, and writing of the manuscript, but has since relocated and cannot be reached to provide final approval of the manuscript. After trying to contact the research student for [time], the corresponding author decides to remove the student's name from the paper, [level of recognition] and publishes the paper.	Experience	• senior experienced • junior inexperienced
		Time	• 1 month • 6 months
		Level of recognition	• recognises their contribution in the Acknowledgements section instead • does not mention the student's contributions in the Acknowledgements section
Self-plagiarism	A [experience] author submitted a systematic review article to Journal X. A peer reviewer commented that parts of the paper reproduced work previously published by the same author in a textbook chapter. The reviewer claimed that about [quantity] of the text, mainly [material], appeared to be identical without any reference to the textbook chapter.	Experience	• senior experienced • junior inexperienced
		Quantity of overlapping material	• 10% • 35%
		Material	• in the Introduction section and the Methods describing the literature search strategy • describing the interpretation of the literature

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Topic	Vignette	Variable for randomisation	Statements varied
Honorary authorship	Three [experience] authors from the same institution conducted a research study and wrote it up as a paper for publication. With agreement from the co-authors and after preparing the manuscript for submission, the corresponding author invited a fourth researcher to be the last-listed author. This author, a [seniority of fourth author], was familiar with the subject matter of the paper but had not been involved with the study. After agreeing to be an author, the fourth researcher gave [contribution].	Experience	• senior experienced • junior inexperienced
		Seniority of fourth author	• professor and head of department • junior inexperienced researcher who had not previously co-authored a research paper
		Contribution	• general advice on how to improve the Discussion section and identified some typographical corrections on reading the final version of the manuscript before submission • general advice on how to improve the Discussion section but did not read the final version of the manuscript before submission
Conflict of interest	A [experience] researcher submitted an unsolicited narrative review article to a medical journal. The article reviewed the treatment benefits of several major pharmaceutical products commonly used in the field. [Length of conflict] prior to this, the researcher [financial arrangement with company], but did not mention this on submission of the review.	Experience	• senior experienced • junior inexperienced
		Length of conflict	• One year • Three years
		Financial arrangement with company	• received a research grant from Company X in relation to a product discussed in the review article • received speaking fees from Company X for a lecture at a conference that included a discussion of a product included in the review article

Notes: The name of the variable that was randomised is included in square brackets in the second column and the actual statements randomised are in the fourth column.

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Figure legends

Figure 1. Flow chart of study participants and analytical sample

Figure 2: Responses by country of work for top 20 contributing countries

Figure 3: Vignette responses
a) Prior publication
b): Author omission
c): - Self-plagiarism
d): - Honorary authorship
e): - Conflicts of interest

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Figure 1. Flow chart of study participants and analytical sample

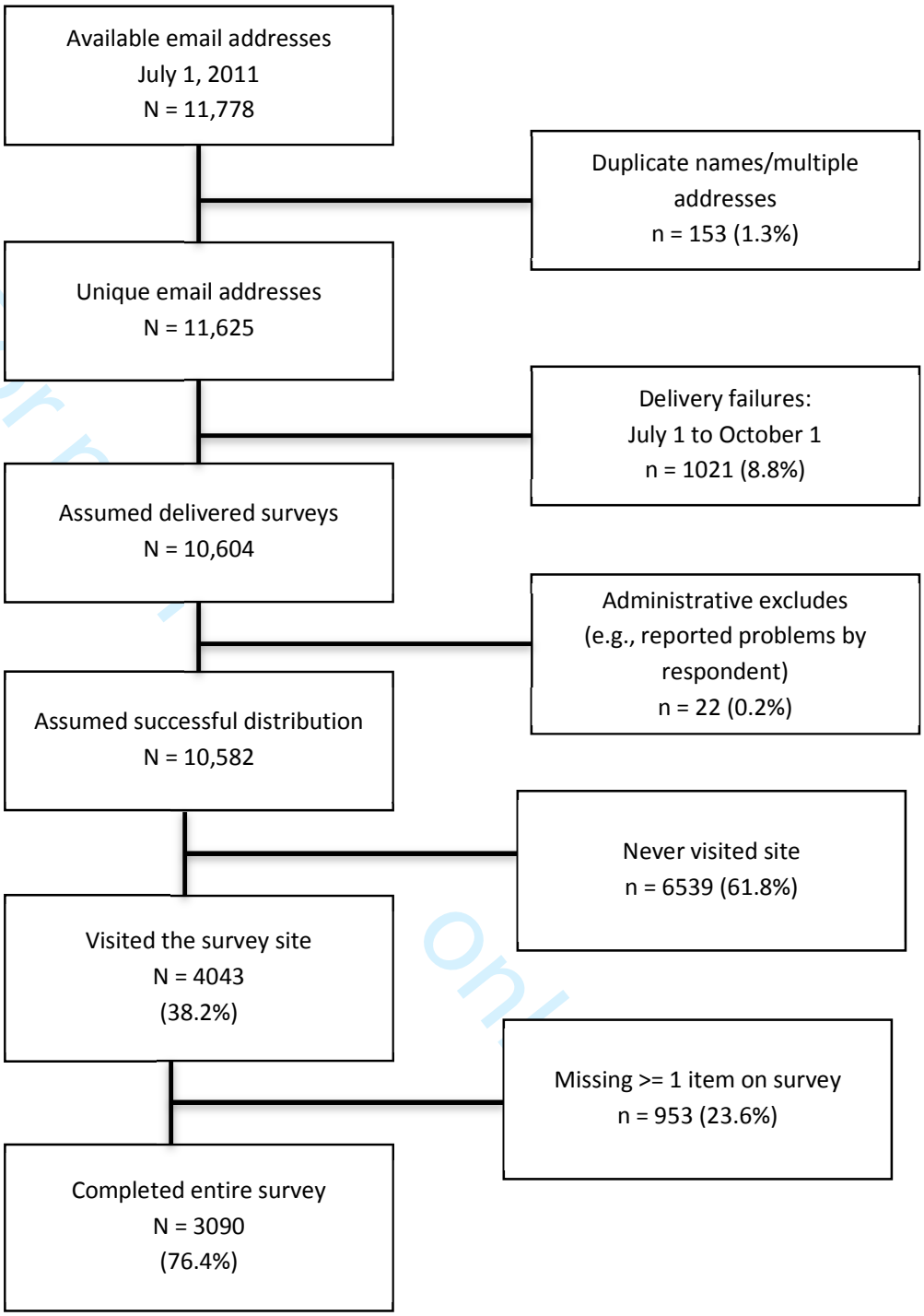

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Figure 2: Responses by country of work for top 20 contributing countries

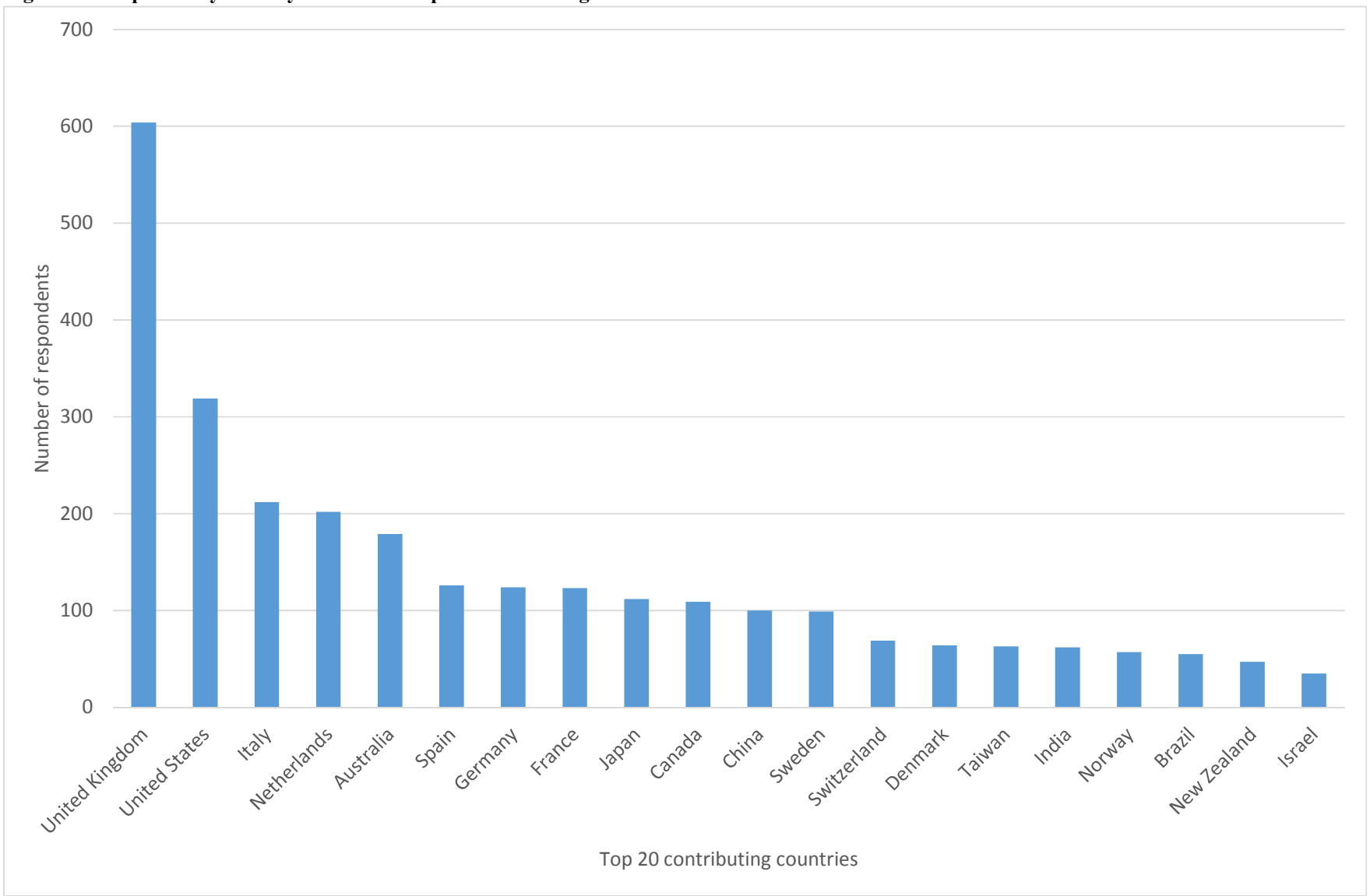

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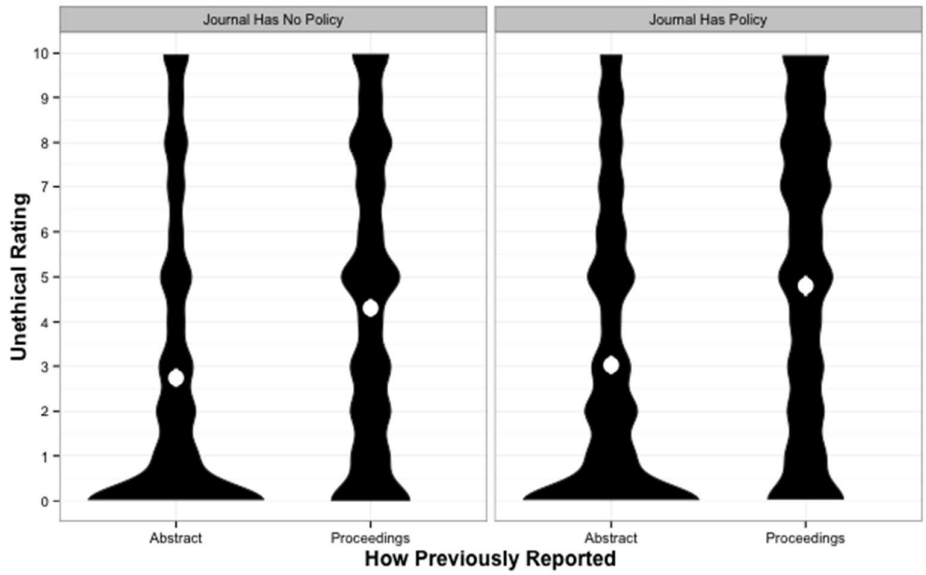
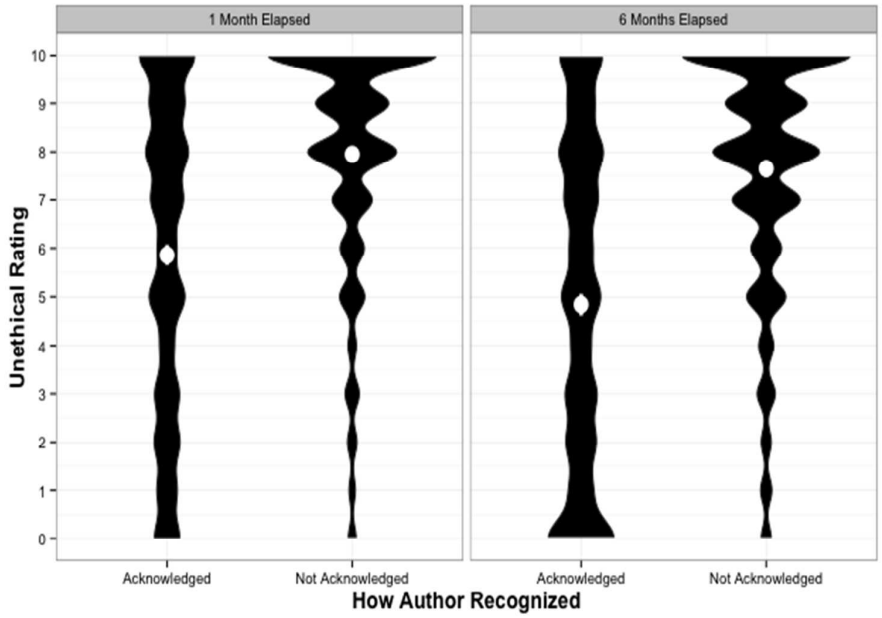
Figure 3: Vignette responses

a) Prior publication



b) Author omission



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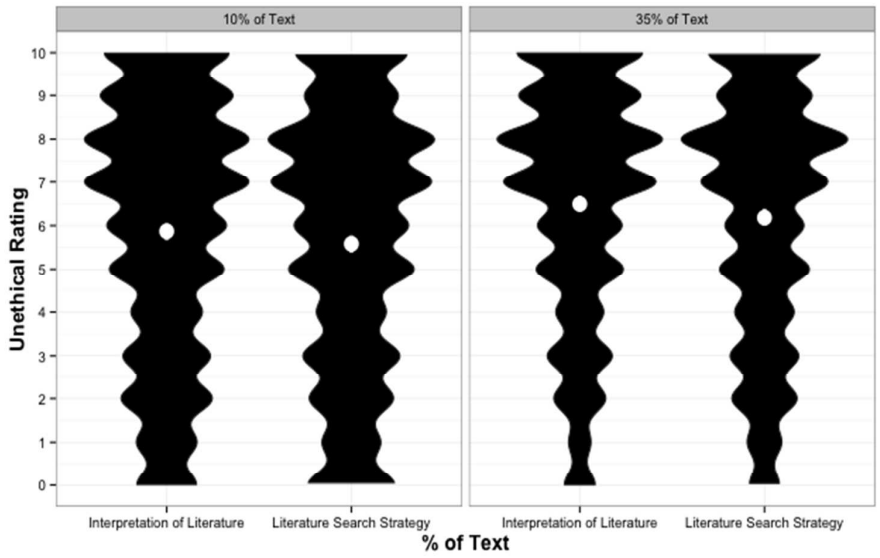
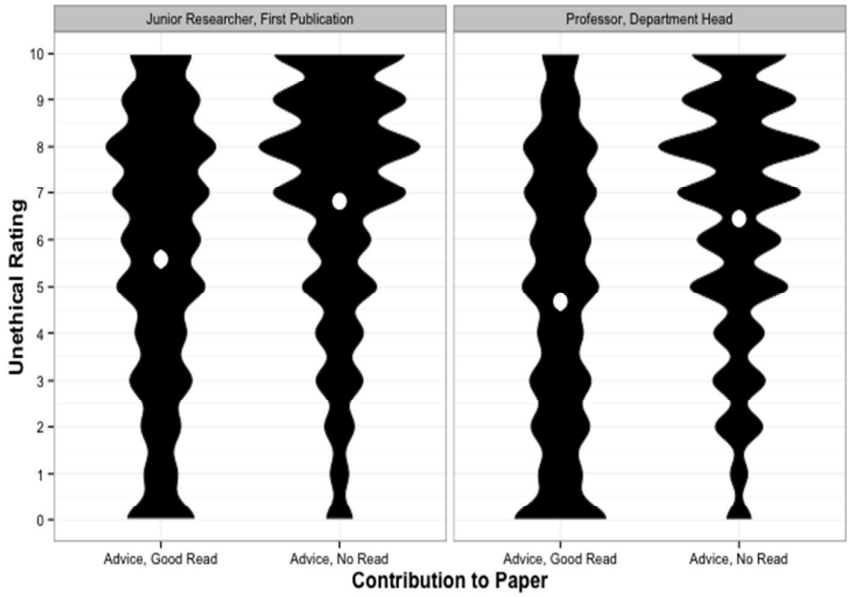
c) Self-plagiarism



d) Honorary authorship



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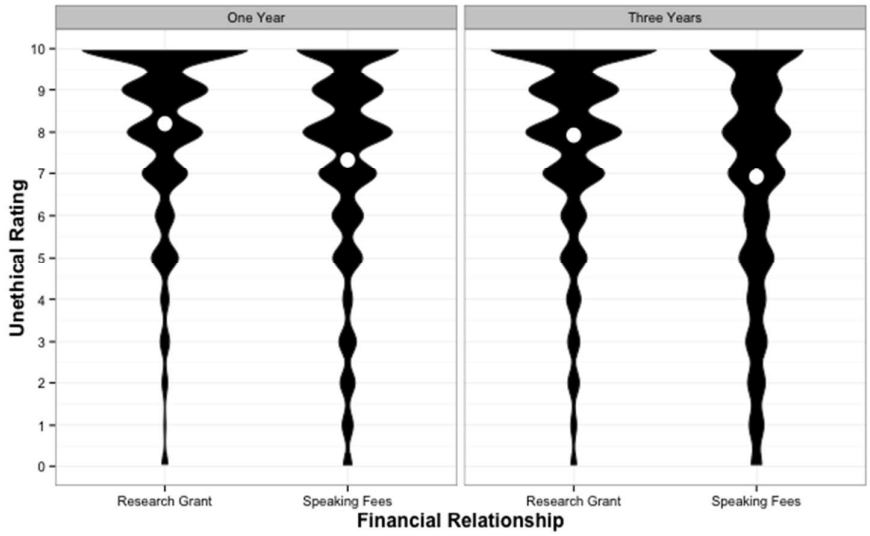
e) Conflicts of interest



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Biomedical Authors' awareness of publication ethics: An international survey

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Biomedical Authors' awareness of publication ethics: An international survey

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Abstract

Objective

The extent to which biomedical authors have received training in publication ethics, and their attitudes and opinions about the ethical aspects of specific behaviours, have been under-studied. We sought to characterise the knowledge and attitudes of biomedical authors about common issues in publication ethics.

Design

Cross-sectional online survey.

Setting and participants

Corresponding authors of research submissions to 20 journals.

Main Outcome Measure(s)

Perceived level of unethical behaviour (rated 0 to 10) presented in five vignettes containing key variables that were experimentally manipulated on entry to the survey and perceived level of knowledge of seven ethical topics related to publishing (prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism).

Results

4043/10,582 (38%) researchers responded. Respondents worked in 100 countries and reported varying levels of publishing experience. 67% (n=2700) had received some publication ethics training from a mentor, 41% (n=1677) a partial course, 28% (n=1130) a full course, and 55% (n=2206) an online course; only a small proportion rated training received as excellent. There was a full 0 to 10-point range in ratings of the extent of unethical behaviour within each vignette, illustrating a broad range of opinion about the ethical acceptability of the behaviours evaluated, but these opinions were little altered by the context in which it occurred. Participants reported substantial variability in their perceived knowledge of 7 publication ethics topics; one-third perceived their knowledge to be less than “some knowledge” for the sum of the seven ethical topics and only 9% perceived “substantial knowledge” of all topics.

Conclusions

We found a large degree of variability in espoused training and perceived knowledge, and variability in views about how ethical or unethical scenarios were. Ethical standards need to be better articulated and taught to improve consistency of training across institutions and countries.

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Strengths and limitations of this study:

- Large survey providing a snapshot of author's awareness of publication ethics at a single point in time
- Included authors from a range of journals, disciplines, countries and with varying levels of research and publishing experience
- Responses were based on short hypothetical vignettes rather than personal experience

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Introduction

Many biomedical scientists report substantial pressure to produce numerous research publications, in part because the number of papers published is the main metric in most academic promotion systems. [1] In some cases, this pressure to publish may lead to ethical lapses, such as plagiarism, self-plagiarism (text recycling), ghost or honorary authorship, or failure to report competing interests. [2-7]

The increasing pressure to publish has not been matched with widespread training for researchers about ethical matters that are commonly encountered in the process of scientific publication. The Committee on Publication Ethics (COPE) provides such training for biomedical editors, but opportunities for biomedical researchers to learn about these ethical issues are not always available or required. If available, they often do not focus in-depth on such matters. [8] As with peer review, it may be assumed that researchers already have this knowledge or will learn on the job from mentors.

Previous research has identified considerable variation in knowledge and attitudes about publication ethics among biomedical scientists. For example, in one survey of 324 post-doctoral fellows a substantial proportion of respondents thought that being "head of the lab" or obtaining study funding were enough to qualify as an author on publications. [9] Around 20% of respondents reported that they had been unfairly omitted as an author. 38% of those who had been authors on previous publications reported that a co-author had not met authorship requirements.

Another study aimed to characterise professional norms regarding publication ethics among US grant-receiving scientists and research administrators. [10] This large study used a factorial vignette design. Virtually all respondents thought that fabrication, falsification, and plagiarism were unethical, but there was poor consensus regarding other behaviours such as making deliberately misleading statements about a paper, sloppiness, or failure to report conflicts of interest. Some research suggests that views about publication ethics may vary based on culture or scientific discipline. [11-13]

The goal of this study was to evaluate the prevalence and quality of formal training in publication ethics among biomedical authors, and to elicit their attitudes and opinions about specific behaviours. We define publication ethics as professional conduct that, in the words of COPE, “reflect[s] the current best principles of transparency and integrity.” We chose to focus on some of the topics emphasised by COPE in its educational activities for authors and editors. We aimed to study a large group of authors from diverse specialties and geographic locations. We also sought to determine whether views differed depending on level of research experience, location of training or practice, or specific mitigating or aggravating contextual circumstances that might be expected to alter perceptions about the seriousness of ethical lapses.

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Methods

Sample

Between 01 August and 30 September 2011, we surveyed corresponding authors of research submissions to 20 biomedical journals in a range of specialties published by The BMJ Publishing Group. The participating journals vary in terms of volume of research received, Impact Factor and acceptance rates. Contact information and other details of authors were obtained from the electronic manuscript tracking systems of each journal. All corresponding authors of research paper submissions in 2009 were eligible for inclusion in the study. We removed duplicate authors to ensure each author was invited only once.

Procedures

Eligible authors were sent a personalised invitation to complete a survey regarding publication issues on an independent secure website. As an incentive to participate, respondents were entered into a prize draw to win a donation of £500 to a choice of charities. Consent was implied by completion of the survey. Respondents were told that their responses would be treated confidentially and held on a secure server. They were also told that editors would not see named individual responses. Two reminders to complete the survey were sent to non-responders at approximately two weeks and two months after the initial mailing. We did not survey non-respondents to learn their reasons for nonresponse.

Questionnaire development and piloting

Questionnaire content and vignettes were developed from discussion with experts in publication ethics, and based on ethical problems encountered by BMJ editors and other members of the research team. The questionnaire was administered to four experts in publication ethics and two experts in survey design to confirm content validity and to check for ambiguous questions. It was then piloted with convenience samples of students and editorial assistants. We ran two further pilots (with 45 members of the editorial board of *Anesthesiology* and a sample of 100 submitting authors) to estimate response rate and burden. To reduce respondent burden, the questionnaire was shortened by reducing the complexity and number of vignettes based on these results.

Survey instrument

The questionnaire (Appendix 1) assessed the level of awareness of good publication practices. It had three sections: 1) vignettes describing a situation on a range of topics (prior publication, exclusion of an author, self-plagiarism, honorary authorship, and undeclared conflicts of interest); 2) questions about the respondent's perceived level of knowledge of seven ethical topics; and 3) questions about respondent characteristics. We developed customised survey software for this project so that we could randomise submitting authors to receive different presentations of the vignettes. We recorded the elapsed time completing the survey and present this data using median [25th, 75th].

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Vignettes

Respondents were shown a series of five vignettes. Each vignette was a short paragraph describing an ethical scenario (prior publication, author omission, self-plagiarism, honorary authorship, and undeclared conflicts of interest). There were several permutations of each vignette to determine the importance of mitigating or aggravating factors on perceptions of the seriousness of ethical lapses. Specifically, within each vignette there were three variables, each with two possible statements. Box 1 shows the five vignettes and the statements randomised within each. For example, within the vignette about self-plagiarism, respondents were randomised to rate a vignette that described a more or less experienced corresponding author, the presence or absence of a journal policy prohibiting self-plagiarism, and the type of previous publication of the plagiarised material (conference proceedings or abstract at a meeting).

Participants were randomised to receive different combinations of possible statements for each vignette. They were asked to rate how unethical they thought the researcher's behaviour was on a numerical rating scale (0=Not at all unethical, 10=Extremely unethical), similar to that used in a previous study. [8] With the exception of the prior publication vignette, which described a situation that was not considered unethical and was always presented first, the vignettes were selected and presented at random on entry to the survey. Each vignette was presented on its own page and respondents were not allowed to return to a vignette and change their ratings after moving to the next page.

Perceived knowledge

Respondents were given a short definition of seven ethical topics and asked to indicate their level of knowledge (0=no knowledge, 1=some knowledge, 2=substantial knowledge) of each topic: prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism.

Respondent characteristics

Participants were asked their gender, age, work specialty, country of work, country of training, number of years spent as an active researcher, number of research papers published, number of articles they peer review each year, whether they had performed editorial roles, and to rate the perceived quality of the training or guidance they had received on the ethics of publishing scientific research.

Statistical analysis

TH conducted all statistical analyses and was blinded to the identities of the respondents. Prior to the analysis the data were inspected for completeness and accuracy. Missing data were examined based on participant and response characteristics. All available data were used for the analysis and all reported analyses were pre-specified. Descriptive statistics for the other measurements were reported based on the nature of the underlying data: medians [25th, 75th percentile] are used for data with at least ordinal properties and frequency counts (%) are used for categorical data.

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We compared respondents with non-respondents by country in which they were based, the journal to which they submitted, and whether the paper they had submitted to the journal was peer reviewed or not. Correlations between items were estimated using Kendall's Tau correlation to account for ties in the ordinal scales. Comparisons for categorical data were conducted using chi-squared tests. The primary analysis was conducted for each vignette using several generalized linear models with perceived 'unethicalness' as the outcome variable and randomised condition as the predictors. This resulted in a fully crossed design where all combinations of conditions in Box 1 were presented across participants (each participant completed only one version of each vignette). For the models, the three between-subjects categorical main effects for each condition were entered along with all two-way interactions and a three-way interaction. Higher order interactions were interpreted such that combinations of the randomised conditions induced differences in unethicalness scores that were conditional on the levels of the other conditions. The rank order of presentation of each vignette was adjusted as an additional covariate to control for order effects. Where appropriate, all analyses are two-tailed and statistical significance is inferred for $p < 0.05$. We did not adjust for multiple comparisons. R statistical software (R Core Team, 2012) was used for all analyses. [14]

Patient and Public Involvement

We did not include patients as study participants. Patients were not involved in setting the research question, designing the study, the conduct of the study, or the interpretation of the results.

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Results

Respondent characteristics

After correcting for delivery failures, 10,582 people were sent an invitation. 4,043/10582 (38%) completed at least some of the survey. Of those responding 3,090 (76%) completed the entire survey, 3,668 (91%) rated at least one vignette. Having an article peer reviewed (34.5%) versus not peer reviewed (33.7%) was not related to the response rate, p = 0.339. For those who completed the entire questionnaire, the median time to complete was 8 [5, 12] minutes.

Respondents reported they worked in 101 countries. Figure 1 displays the number of responses received based on country of work for the top 20 contributing countries. Of the countries that had greater than n=100 individuals who were sent surveys, the likelihood of surveys being returned varied widely between countries. For example, 53/102 (51.9%) of individuals from New Zealand returned surveys, while only 34/194 (17.5%) of individuals from Korea returned surveys. The three countries with the highest response rates were New Zealand (51.9%), Norway (45.9%), and Sweden (44.5%). The three countries with the lowest response rates were Korea (17.5%), unreported country (26.0%), and Finland (26.8%).

Respondents had a median [25th, 75th] age of 44 [37, 52], almost half reported their main language was not English, and 30% were female and 50% male (Table 1). Roughly 17% of the 3,222 respondents who disclosed their country of training and country of work reported that they received postgraduate education in a country that was different to their current country of work. Respondents ranged in research experience; 254 (6%) had less than 10 years of experience and 510 (13%) had over 25 years. Respondents completed a median of 5 [2, 10] peer reviews a year and had published a median of 30 [10, 70] articles in their career. 1073 (26.5%) of the respondents reported serving on at least one journal editorial board.

Perceived Knowledge of Publication Ethics

Participants reported substantial variability in the perception of their own knowledge about seven ethical topics (Table 2). Substantial knowledge in the seven topics ranged from 21.3% for author omission to 60.5% for conflicts of interest. Participants' scores on each of the seven domains of perceived knowledge were only moderately correlated (r = 0.21 to 0.50, p's < 0.001; Table 2). The individual items were summed to create a total score, which demonstrated good internal consistency ($\alpha = 0.84$ and item-total correlations <0.30). Perceived knowledge on one domain was a good predictor of how a participant perceived their overall knowledge of these issues. One-third (33.7%) of the participants perceived their knowledge to be less than "some knowledge" for the sum of the seven listed ethical topics. Only 8.8% of participants indicated that they possessed "substantial knowledge" on all seven topics.

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Training in Publication Ethics

Training from a mentor was the highest rated source, with 43% of the sample reporting perceiving at least a "good" or "excellent" level of training from a research mentor (Table 3). Formal training was less common, with 51% of respondents reporting they have never participated in a full course on publication ethics, and less than half (42%) reporting receipt of some ethical training in partial coursework. The most commonly reported source of training was online courses, with 55% of the sample reporting this type of experience, but only 31% rated the quality of this online training as "good" or "excellent".

Perceived quality of previous training was positively associated (phi =0.45, $p<0.001$) with perceived knowledge scores, indicating that individuals with higher levels of perceived quality of previous training endorsed higher perceptions of knowledge about ethical issues. To estimate this association, we coded each respondent's highest perceived quality rating from any of their previous training sources, and estimated an association with their perceived knowledge total score. The highest score was used because it was not expected that participants would receive training from all sources and high levels of perceived quality from any single source could impact perceived knowledge.

Vignettes

Figures 2-6 display the unethical ratings for each vignette as a function of the experimental manipulations using violin plots. Each one of the experimental conditions (x-axis) is plotted using the smoothed frequency of responses by unethical rating (y-axis). The width of the plot at each rating corresponds to the relative frequency of responses for that rating. As can be observed in the plots, a great deal of variability was observed for all vignettes with all conditions exhibiting the full range of possible responses (0 to 10 scores). There were no higher-order interactions among the experimental manipulations for any of the vignettes, allowing main effects to be interpreted. For all except the conflict of interest vignette ($p=0.006$), the level of experience of the researcher described did not significantly influence responses ($p>0.05$). Findings for each vignette are presented below.

Prior publication

For this vignette, the experimental manipulations accounted for a statistically significant ($p < 0.0001$), though only small amount (6.4%), of the total variability in responses. If the journal had a policy about previous publication, the behaviour described in the vignette was rated as 0.38 points (95%CI: 0.16 to 0.60, $p = 0.0006$) more unethical than if the journal did not possess a policy (Figure 2). If the previous submission was published in proceedings from a conference, the behaviour was rated as 1.68 points (95%CI: 1.46 to 1.89, $p < 0.0001$) more unethical than if it were only previously reported as an abstract.

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Author omission

The experimental manipulations accounted for only 16% of the total variability in responses ($p < 0.0001$),. The order in which this vignette was presented to respondents influenced ethical ratings of the behaviour it described. Respondents who viewed the vignette later rated the behaviour it described as -0.18 points less unethical for each previous vignette encountered. The time elapsed since contact was lost with the author influenced ratings of the vignettes with 6 months elapsed rated as -0.64 points (95%CI: -0.84 to -0.45., $p < 0.0001$) less unethical than if only 1 month had elapsed (Figure 3). If the missing author was formally acknowledged, the practice was rated as - 2.45 points (95%CI: -2.64 to -2.26, $p < 0.0001$) less unethical than if they were not acknowledged.

Self-plagiarism

The experimental manipulations accounted for only 1.5% of the total variability in responses ($p < 0.0001$). The order in which the vignette was presented did not influence ratings ($p = 0.71$). The quantity of self-plagiarised material did influence ratings of the behaviour described in the vignette, with 35% of the material being plagiarised rated as 0.61 points (95%CI: 0.42 to 0.80, $p < 0.0001$) more unethical than if only 10% had been plagiarised (Figure 4). If the plagiarised sections included the literature interpretation, the practice was rated as 0.30 points (95%CI: 0.11 to 0.49, $p = 0.002$) more unethical than if only the literature search strategy was plagiarised.

Honorary authorship

The experimental manipulations accounted for only 8.2% of the total variability in responses ($p < 0.0001$). The randomised order in which this vignette was presented to respondents did influence ethical ratings of the behaviour it described. Those who viewed the vignette later rated behaviour as -0.14 points less unethical for each previous vignette encountered.

The experience of the researcher did not influence responses, with distinctions between senior and junior researchers accounting for only 0.11 points on a 10-point unethical scale (95%CI: -0.08 to 0.30, $p = 0.08$) (Figure 5). However, the seniority of the added author did influence ratings, with added junior authors (submitting their first paper) rated as 0.64 points (95%CI: 0.45 to 0.82, $p < 0.0001$) more unethical than added senior professors (heads of department). If the contribution of the added author included a careful reading of the manuscript (e.g. correcting typographical errors) as well as advice, the practice was rated as -1.51 points (95%CI: -1.70 to -1.32, $p < 0.0001$) less unethical than if only general advice was offered without a careful reading of the manuscript.

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Conflicts of interest

The experimental manipulations accounted for only 4.2% of the total variability in responses ($p < 0.0001$). The randomised order in which this vignette was presented to respondents affected ethical ratings, with later viewings rating the described behaviour as 0.19 points more unethical for each previous vignette encountered.

The experience of the researcher did influence responses, with distinctions between senior and junior researchers accounting for -0.28 points on a 10-point unethical scale (95%CI: -0.45 to -0.12, $p = 0.0006$) (Figure 6). The duration elapsed since the conflict of interest influenced ratings of the vignettes; 3 years since the conflict was rated as -0.35 points (95%CI: -0.52 to -0.19, $p < 0.0001$) less unethical than if the conflict was more recent (1 year). If the conflict of interest consisted of receiving speaking fees, the practice was rated as -0.93 points (95%CI: -1.10 to -0.77, $p < 0.0001$) less unethical than if a research grant was involved.

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Discussion

Only a small minority of biomedical researchers reported a substantial level of knowledge about the ethical matters evaluated in this study. Most had not had a full course of formal training in publication ethics. Instead, informal training from mentors, who themselves possibly had not received formal training, was common. Our results are consistent with studies done several decades ago that found low levels of training in research ethics among graduate students and postdoctoral fellows. Three studies in the 1990s reported low levels of training or guidance in research ethics among students from the US. [9, 15, 16]

Although individual respondents clearly distinguish among publication practices that are more or less ethical, there is a striking lack of consensus on many matters, especially self-plagiarism and inappropriate authorship. Prior work suggests that opinions on these two topics vary considerably. [17, 18] The lack of agreement about the seriousness of the topics presented might reflect either unreliability of the assessment paradigm or true disagreement among respondents regarding the behaviour that is described. Since most respondents did not receive what they considered to be good ethical training, the latter seems most likely. In the absence of formal, standardised training in publication ethics, respondents presumably relied on their own experience and beliefs to determine whether and to what extent something was unethical.

In a previous study, conflicts of interest were condemned most strongly when there was failure to disclose a financial interest, and deliberate plagiarism was judged more harshly than when it was unintentional. [10] We thus tested several versions of each of our vignettes to see whether there were specific circumstances that altered judgments about the ethical appropriateness of each behaviour. For example, junior faculty report that they feel an obligation to add guest authors to papers if that person is an administrative superior. [19] It seemed reasonable to expect that being a junior rather than a senior researcher might cause respondents to view an ethical lapse as less serious. To our surprise, however, this was not the case, a finding that replicates previous work showing that sex and academic seniority of a scientist did not affect malfeasance ratings. [10]

This was also true for the other altered variables. More than 84% of the variance in ethical ratings was unrelated to the experimental manipulations within the vignettes; these accounted for only 1.5% to 16% of the variance in ethical ratings. This suggests that although there is a broad range of opinion about the ethical acceptability of the behaviours we evaluated, these opinions are little altered by the context in which it occurs. In other words, at least among our sample of active biomedical researchers, respondents appear to judge certain behaviours to be intrinsically ethical or not.

Strengths and limitations

Our study has a number of strengths. It is the largest survey of its kind, with over 3000 responses from active researchers submitting research papers to a range of peer-reviewed specialty journals and a general medical journal. We included authors who had received both rejection and acceptance decisions so that the sample

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would be representative of researchers in general, not just those who succeeded in publishing in the selected journals. The survey also includes responses from researchers who have worked and trained in a large number of countries and institutions. This is in contrast to previous surveys that have been smaller or have focused on a single country, discipline or institution. [9, 10, 15, 16]

Our study also has a number of limitations. The response rate of 38% is low. It is possible that the complexity of the survey or the sensitive nature of the topic discouraged some participants. It is also possible that institutional spam filters prevented our emails from reaching respondents. However, physician responses to web surveys are known to be declining and the response rate to our survey is similar to that reported in a large survey of doctors [20] and higher than that of a large survey of international authors on attitudes to peer review in 2009 [21] Additionally, the response rate to this survey is in the same range as other surveys on this sensitive topic, which have ranged from 27 to 33%. [9, 16, 22]

Although we observed some order effects, these were small and the randomised order of vignette presentation makes it unlikely this has produced any bias in our results. The journals in our study are all published by the BMJ Publishing Group and are relatively high profile journals with a strong commitment to ethical standards. At the time of the survey, many of these journals provided guidance about matters of publication ethics on their website or during the submission process. This might have affected author awareness and views about some of the behaviours that we studied. Thus, our results may not be generalisable to authors submitting to other journals. Response bias, in any variety of forms, is always of concern in a survey study of this type. Although we could examine several obvious sources of responder bias (e.g. author experiences in submission), we took great care in blinding participant identities to best ensure anonymity, so we could not collect extensive information on non-responders for the purposes of comparison with responders.

Although we piloted and revised the vignettes based on feedback, it remains possible that respondents might not have interpreted them as intended.

Study Implications

Our study of a diverse group of biomedical researchers shows that the prevalence of formal training in publication ethics is low, and when training is received it is often perceived to be of low quality. Although it is tempting to suggest that efforts are needed to improve the availability of formal training in publication ethics, such action may be premature. The authors of a recent Cochrane review evaluating the effectiveness of educational or policy interventions addressing research integrity and responsible conduct of research concluded that the effectiveness of these interventions on reducing misconduct is uncertain owing to the very low quality of the available evidence. [23] There is a surprising lack of consensus among researchers about the ethical seriousness of behaviours that many experts consider to be inappropriate, although even experts do not always agree. [24]

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Readily available, standardised training might help, but first we need to understand the reasons for these divergent views to design effective instruction. Once this is done, a strong case can be made that educational efforts should begin with medical journal editors and senior researchers, rather than those who are more junior. The rapid growth of the Committee of Publication Ethics (COPE) from a handful of editors fifteen years ago to a current membership of thousands illustrates the desire of editors for guidance on ethical matters. Both COPE and the World Association of Medical Editors (WAME) provide online guidance intended principally for journal editors and publishers. Despite this, even editors of major medical journals, the majority of whom report having had training about editorial responsibilities, have shown poor knowledge of many ethical matters that are commonly encountered in scientific publishing. [25]

Perhaps because of this deficient training and knowledge among editors, medical journals do not always have policies or provide clear or consistent ethical guidance to authors. [26] Some journals have policies based on guidance from COPE but have developed their own standards regarding specific matters such as authorship. [27] Amongst those titles with policies, there are frequently differences in the interpretation and execution of ethical standards. [28]

Perhaps the most practical starting point would be to work harder to identify core ethical matters about which there is little disagreement, while leaving individual journals to develop and impose their own standards about things for which there is less consensus. The biomedical community has a responsibility to articulate and enforce standards of publication ethics in order to maintain public trust in research.

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Competing interests

SS is a full-time employee of the BMJ Publishing Group and has access to all submission data and regularly undertakes research with its authors and reviewers. SM is a former employee of BMJ Publishing Group. EL receives salary support from *The BMJ* for her services as head of research. This is paid to her employing institution (the Brigham and Women's Physician Organization). None of the authors work directly for BMJ Open or are involved in the decision-making process for articles submitted to BMJ Open. This paper was sent out for peer review in the usual way and treated in the same way as all submissions to the journal. TH, JR, DP have no relevant conflicts of interest.

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We received a £5,000 research grant from the Committee on Publication Ethics to conduct the study.

Ethics

We submitted our research proposal to the BMJ Ethics Committee for comment. They did not have any specific ethical concerns about the study design. The research committee of the Committee on Publication Ethics (COPE), which funded the study, also approved the study protocol. Editors of participating journals gave their consent for the study.

Contributorship

All authors (SS, JR, EL, DP, SM, TH) contributed to the design of the study and the survey tool, were involved in regular steering group meetings, and critically reviewed the manuscript and approved the final version before submission. SS, TH and JR wrote the first draft of this manuscript. EL revised the manuscript and reference list and solicited comments from other authors. JR took the lead on reviewing the literature. SS and SM gathered the sample of authors. SS piloted the survey with students and experts. Chadwick de Voss developed the survey software, signed a confidentiality agreement for the BMJ and managed the electronic database. SS managed email responses and bounce backs to the survey. TH conducted all statistical analysis and was blinded to the respondents' identities and signed a confidentiality statement for the BMJ. All authors (SS, JR, EL, DP, SM, TH) helped interpret the findings and approved the final version of the manuscript for publication.

Data Sharing Statement

Data are available upon reasonable request.

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Table 1: Respondent characteristics for those completing at least some of the questionnaire (n=4043)

Characteristic	All respondents (n=4,043)	
Median [25th, 75th] age in years (n)	44 [37, 52] n=3214	
Sex, n (%)		
Male	2030 (50.2%)	
Female	1202 (29.7%)	
Missing	811 (20.1%)	
Previous experience in an editorial role , n (%)		
No	2168 (53.6%)	
Yes	1073 (26.5%)	
Missing	802 (19.8%)	
First (main language), n (%)		
English	1250 (30.9%)	
Other	1915 (47.4%)	
Missing	878 (21.7%)	
Years of research experience		
1 to 2 years	148 (3.6%)†	
3 to 5 years	106 (2.6%)	
6 to 10 years	587 (14.5%)	
11 to 15 years	802 (19.8%)	
16 to 20 years	591 (14.6%)	
21 to 25 years	421 (10.4%)	
26 to 30 years	298 (7.4%)	
> 30 years	212 (5.2%)	
Missing	878 (21.7%)	
Median [25th, 75th] number of peer reviews conducted annually (n)	5 [2, 10] (n=3258)	
Median [25th, 75th] number of papers published (n)	30 [10, 70] (n=3271)	

Note: Not all percentages sum to 100% due to rounding.
Figures are numbers (percent) unless indicated otherwise.

† Due to a computer coding mistake, this value was stored with missing values and was imputed using deterministic methods (i.e., the value was deduced by examining the other responses).

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Table 2: Respondents self-perceived level of knowledge of seven publication ethics topics

Topic	Number completing each question	Perceived knowledge n (%)*			Kendall's Tau correlation						
		None	Some	Substantial	PP	AO	SP	HA	CI	IM	P
Prior publication (PP)	3360	489 (14.6)	1886 (56.1)	985 (29.3)	-						
Author omission (AO)	3363	1265 (37.6)	1380 (41.0)	718 (21.3)	0.36	-					
Self-plagiarism (SP)	3362	227 (6.8)	1409 (41.9)	1726 (51.3)	0.49	0.31	-				
Honorary authorship (HA)	3361	283 (8.4)	2014 (59.9)	1064 (31.7)	0.45	0.36	0.40	-			
Conflicts of interest (CI)	3361	77 (2.3)	1251 (37.2)	2033 (60.5)	0.33	0.21	0.40	0.40	-		
Image manipulation (IM)	3362	125 (3.7)	1456 (43.3)	1781 (53.0)	0.38	0.28	0.48	0.41	0.46	-	
Plagiarism (P)	3364	512 (15.2)	1268 (37.7)	1584 (47.1)	0.45	0.38	0.50	0.43	0.38	0.45	-

* Reported as a proportion of the number who completed each item.

All correlations $p < 0.0001$.

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Table 3: Receipt of and perceived quality of ethical training (n=4043)

		Perceived quality of training received*				
Type of training/guidance	**Not received**	**Poor quality**	**Average quality**	**Good quality**	**Excellent quality**	**Missing data**
Ethical training from a mentor	535 (13.2)	232 (5.7)	718 (17.8)	1146 (28.3)	604 (14.9)	808 (19.9)
Ethical guidance: partial course	1526 (37.7)	156 (3.9)	566 (14.0)	766 (18.9)	189 (4.7)	840 (20.8)
Ethical guidance: full course	2053 (50.7)	117 (2.9)	332 (8.2)	487 (12.0)	194 (4.8)	860 (21.2)
Ethical guidance: self training through online resources	989 (24.5)	164 (4.1)	796 (19.7)	1007 (24.9)	239 (5.9)	848 (21.0)

Note: Percentages do not sum to 100% due to rounding.

*Measured on a 4-point Likert scale (0=poor quality, 1=average quality, 3=good quality, 4=excellent quality).

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Box 1: List of variables randomised within each vignette

Topic	Vignette	Variable for randomisation	Statements varied
Prior publication	A [experience] researcher submitted a manuscript describing the primary results of a study to a medical journal that [journal policy]. A peer reviewer comments that the same study results have already been published [How the study had previously been reported] and that this prior publication means the work is not new and should not be considered for publication by the journal.	Experience	• senior experienced • junior inexperienced
		Journal policy	• prohibits the submission of work that has previously been published • has no policy regarding the submission of work that has previously been published
		Previous reporting of study	• in an abstract at a professional meeting • as a paper in the proceedings from a conference
Authorship omission	A corresponding author, a [experience] member of staff, is ready to submit a manuscript. A research student, helped with the design of the study, data collection, and writing of the manuscript, but has since relocated and cannot be reached to provide final approval of the manuscript. After trying to contact the research student for [time], the corresponding author decides to remove the student's name from the paper, [level of recognition] and publishes the paper.	Experience	• senior experienced • junior inexperienced
		Time	• 1 month • 6 months
		Level of recognition	• recognises their contribution in the Acknowledgements section instead • does not mention the student's contributions in the Acknowledgements section
Self-plagiarism	A [experience] author submitted a systematic review article to Journal X. A peer reviewer commented that parts of the paper reproduced work previously published by the same author in a textbook chapter. The reviewer claimed that about [quantity] of the text, mainly [material], appeared to be identical without any reference to the textbook chapter.	Experience	• senior experienced • junior inexperienced
		Quantity of overlapping material	• 10% • 35%
		Material	• in the Introduction section and the Methods describing the literature search strategy • describing the interpretation of the literature

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Topic	Vignette	Variable for randomisation	Statements varied
Honorary authorship	Three [experience] authors from the same institution conducted a research study and wrote it up as a paper for publication. With agreement from the co-authors and after preparing the manuscript for submission, the corresponding author invited a fourth researcher to be the last-listed author. This author, a [seniority of fourth author], was familiar with the subject matter of the paper but had not been involved with the study. After agreeing to be an author, the fourth researcher gave [contribution].	Experience	• senior experienced • junior inexperienced
		Seniority of fourth author	• professor and head of department • junior inexperienced researcher who had not previously co-authored a research paper
		Contribution	• general advice on how to improve the Discussion section and identified some typographical corrections on reading the final version of the manuscript before submission • general advice on how to improve the Discussion section but did not read the final version of the manuscript before submission
Conflict of interest	A [experience] researcher submitted an unsolicited narrative review article to a medical journal. The article reviewed the treatment benefits of several major pharmaceutical products commonly used in the field. [Length of conflict] prior to this, the researcher [financial arrangement with company], but did not mention this on submission of the review.	Experience	• senior experienced • junior inexperienced
		Length of conflict	• One year • Three years
		Financial arrangement with company	• received a research grant from Company X in relation to a product discussed in the review article • received speaking fees from Company X for a lecture at a conference that included a discussion of a product included in the review article

Notes: The name of the variable that was randomised is included in square brackets in the second column and the actual statements randomised are in the fourth column.

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Figure legends

Figure 1: Responses by country of work for the top 20 contributing countries
Figure 2: Prior publication vignette response
Figure 3: Author omission vignette response
Figure 4: Self-plagiarism vignette response
Figure 5: Honorary authorship vignette response
Figure 6: Conflicts of interest vignette response

Appendix 1: Study questionnaire

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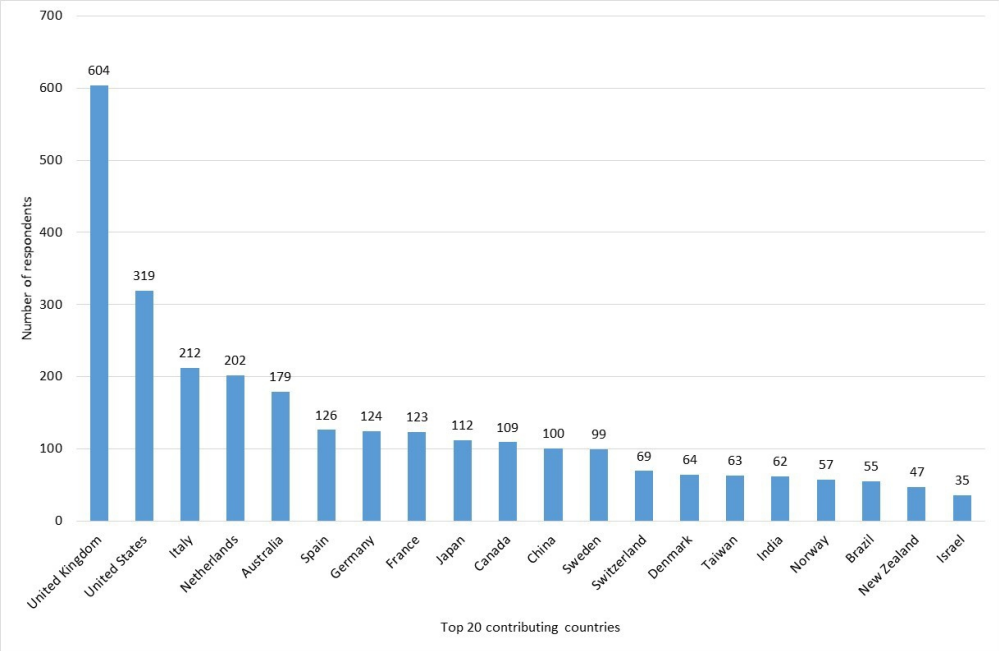

Figure 1: Responses by country of work for the top 20 contributing countries

258x168mm (120 x 120 DPI)

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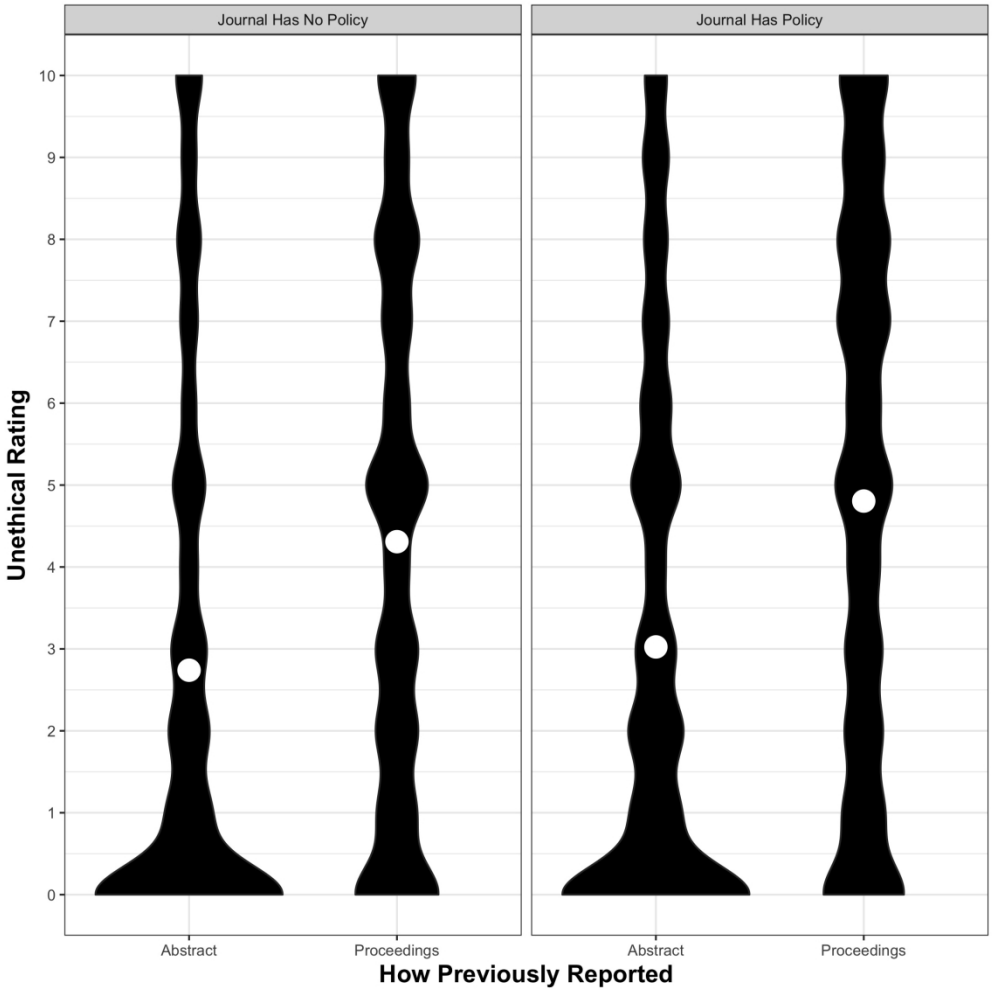

Figure 2: Prior publication vignette response

846x846mm (72 x 72 DPI)

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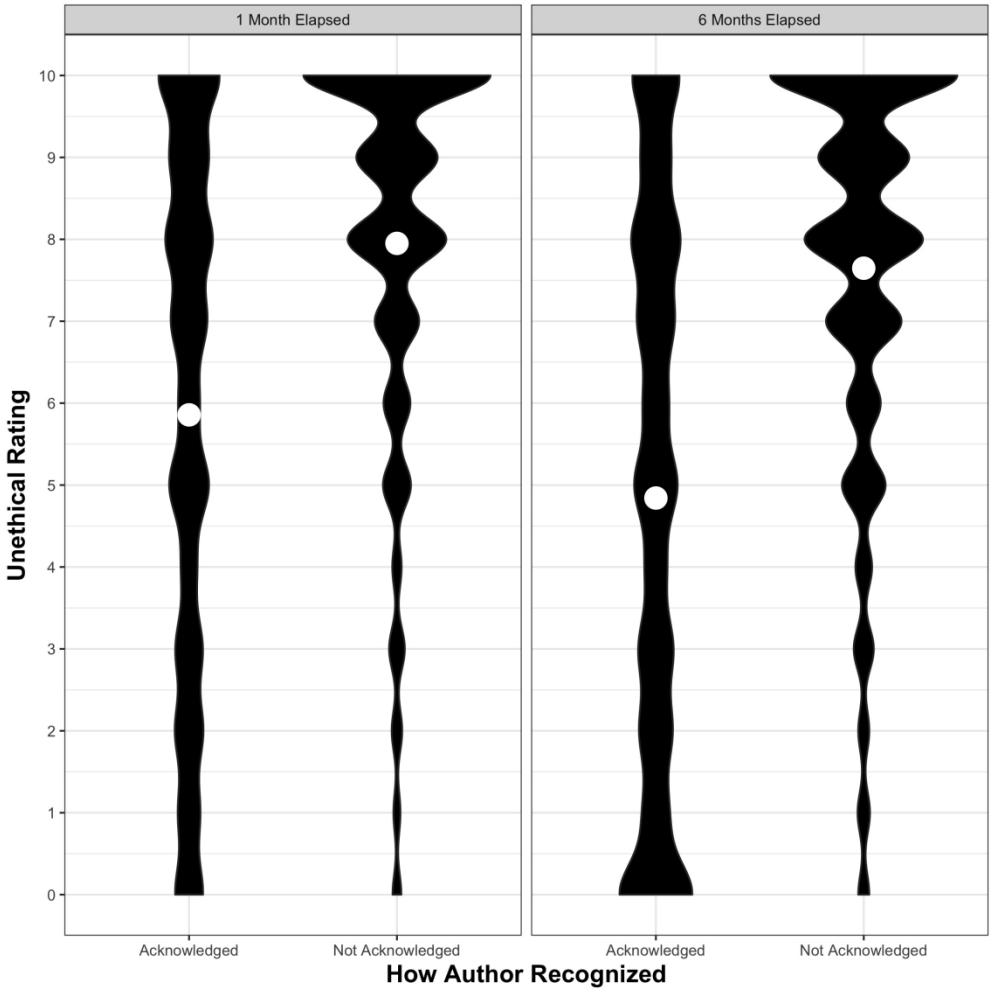

Figure 3: Author omission vignette response

846x846mm (72 x 72 DPI)

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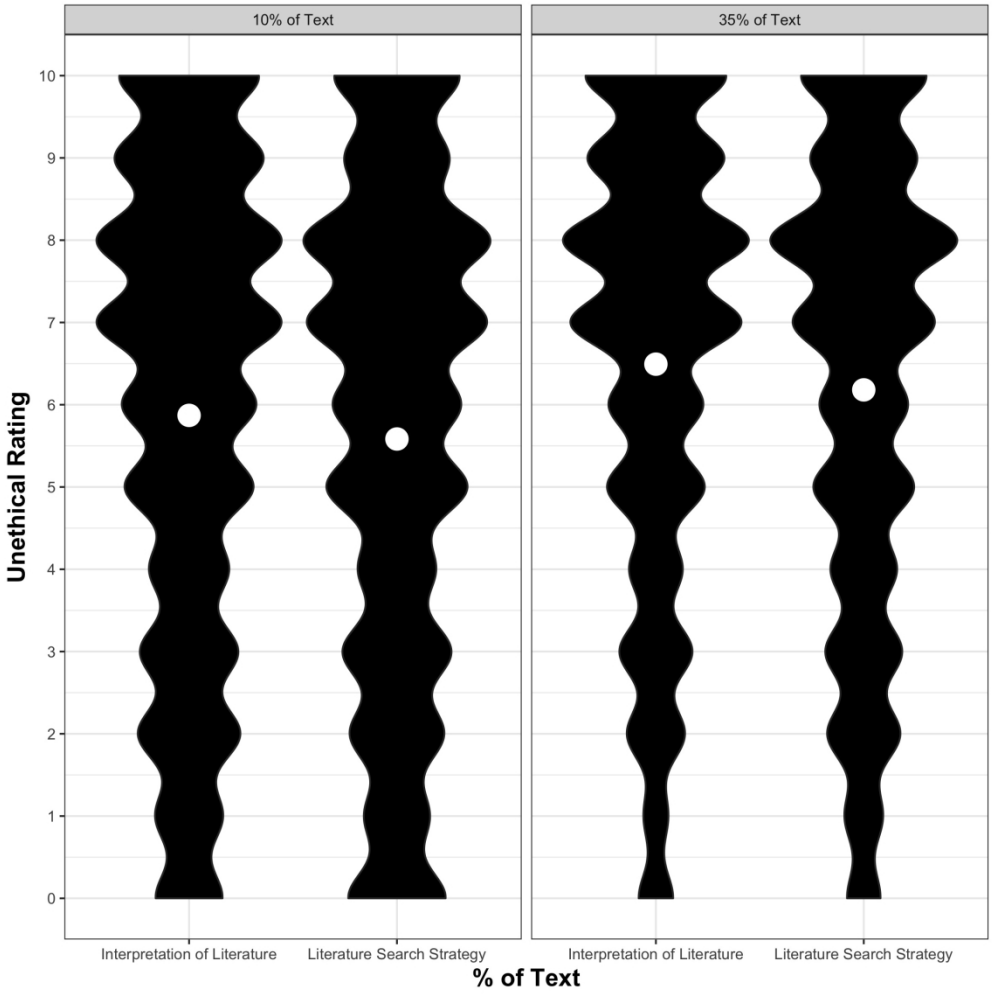

Figure 4: Self-plagiarism vignette response

846x846mm (72 x 72 DPI)

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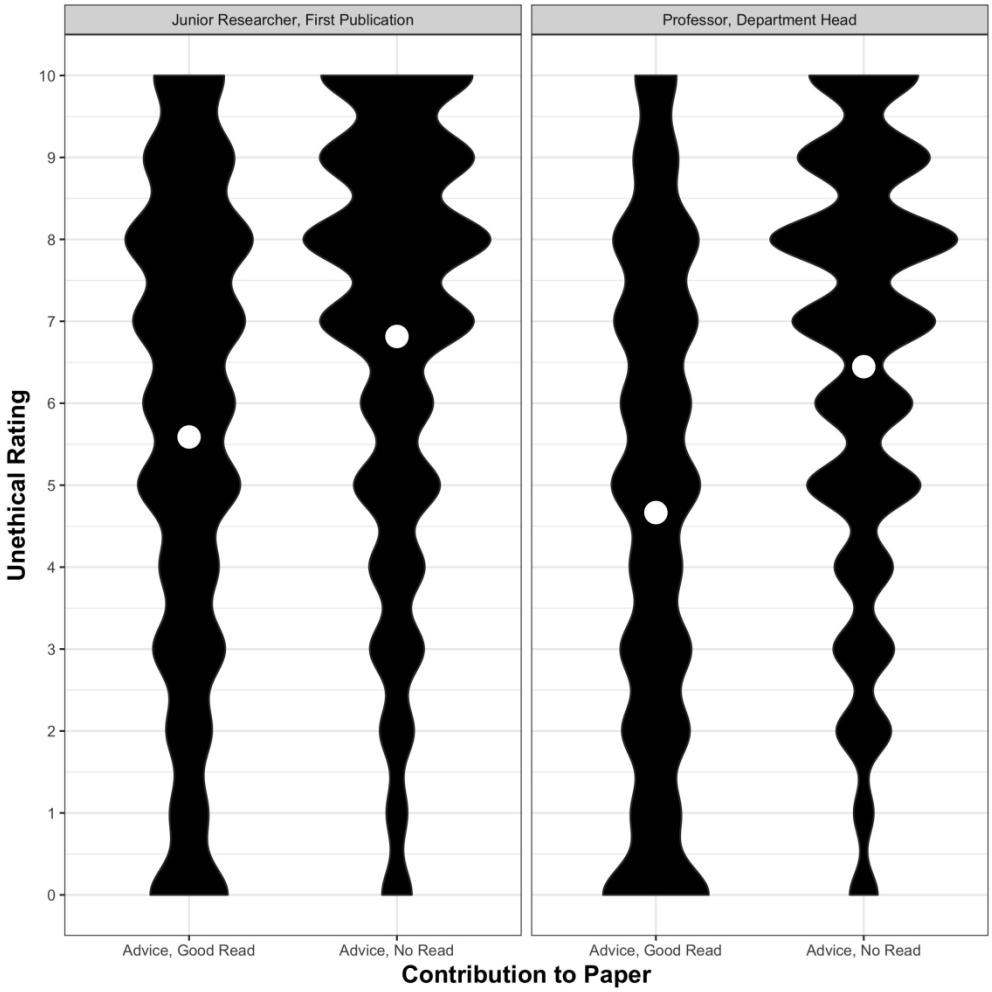

Figure 5: Honorary authorship vignette response

846x846mm (72 x 72 DPI)

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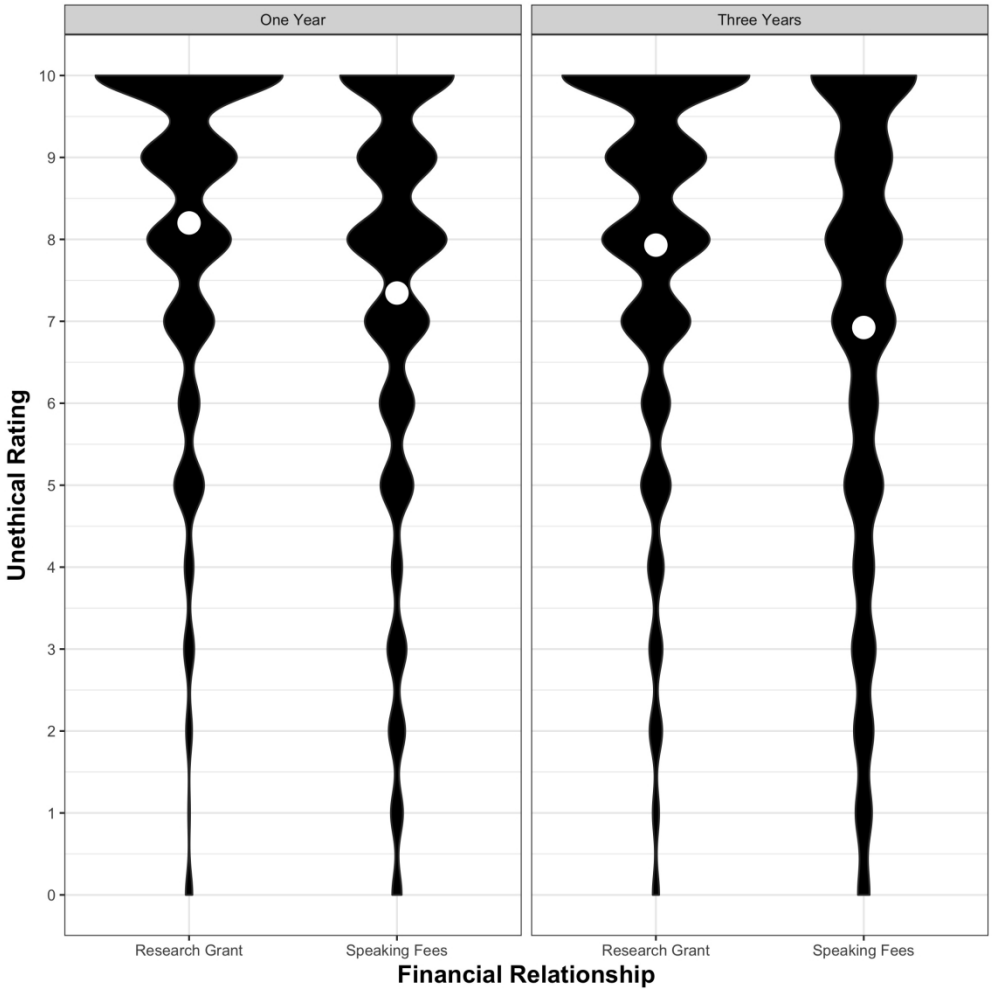

Figure 6: Conflicts of interest vignette response

846x846mm (72 x 72 DPI)

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SECTION 1

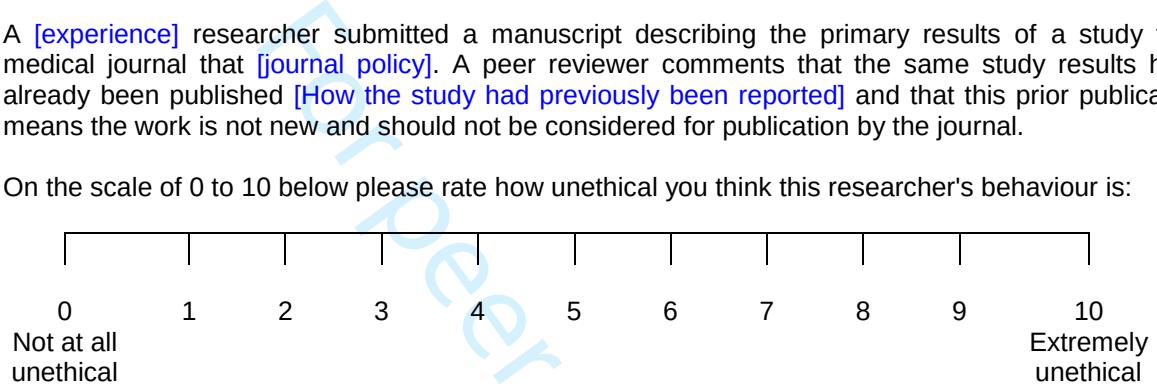
Scenario 1

Variables for randomisation:

1. Experience
   - senior experienced
   - junior inexperienced
2. Journal policy
   - prohibits the submission of work that has previously been published
   - has no policy regarding the submission of work that has previously been published
3. How the study had previously been reported
   - in an abstract at a professional meeting
   - as a paper in the proceedings from a conference

A [experience] researcher submitted a manuscript describing the primary results of a study to a medical journal that [journal policy]. A peer reviewer comments that the same study results have already been published [How the study had previously been reported] and that this prior publication means the work is not new and should not be considered for publication by the journal.

On the scale of 0 to 10 below please rate how unethical you think this researcher's behaviour is:



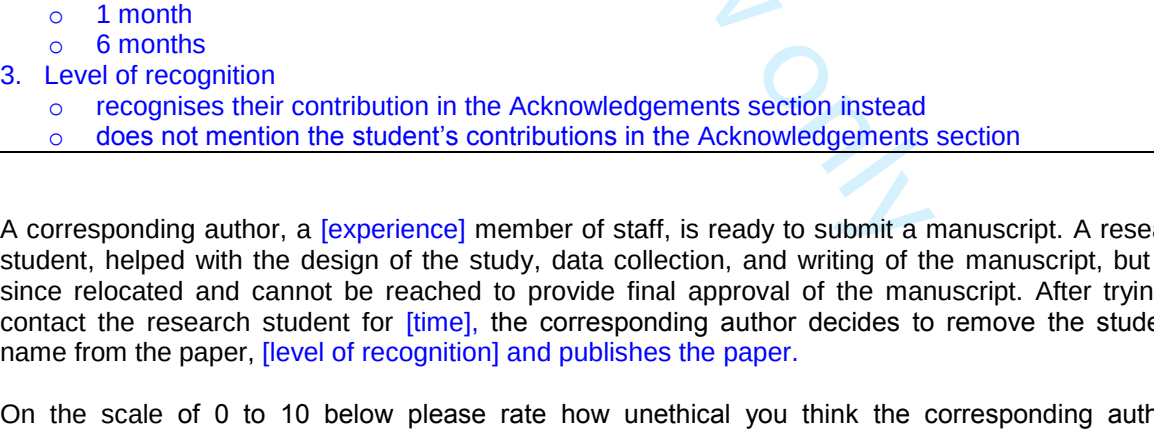
Scenario 2

Variables for randomisation

1. Experience
   - senior experienced
   - junior inexperienced
2. Time
   - 1 month
   - 6 months
3. Level of recognition
   - recognises their contribution in the Acknowledgements section instead
   - does not mention the student's contributions in the Acknowledgements section

A corresponding author, a [experience] member of staff, is ready to submit a manuscript. A research student, helped with the design of the study, data collection, and writing of the manuscript, but has since relocated and cannot be reached to provide final approval of the manuscript. After trying to contact the research student for [time], the corresponding author decides to remove the student's name from the paper, [level of recognition] and publishes the paper.

On the scale of 0 to 10 below please rate how unethical you think the corresponding author's behaviour is:



Scenario 3

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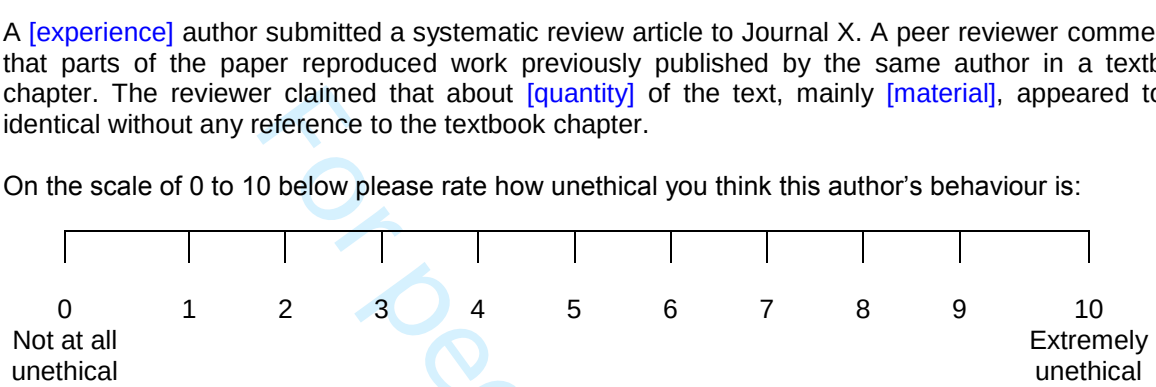
Variables for randomisation:
1. Experience
   - senior experienced
   - junior inexperienced
2. Quantity of overlapping material
   - 10%
   - 35%
3. Material
   - in the Introduction section and the Methods describing the literature search strategy
   - describing the interpretation of the literature

A [experience] author submitted a systematic review article to Journal X. A peer reviewer commented that parts of the paper reproduced work previously published by the same author in a textbook chapter. The reviewer claimed that about [quantity] of the text, mainly [material], appeared to be identical without any reference to the textbook chapter.

On the scale of 0 to 10 below please rate how unethical you think this author's behaviour is:

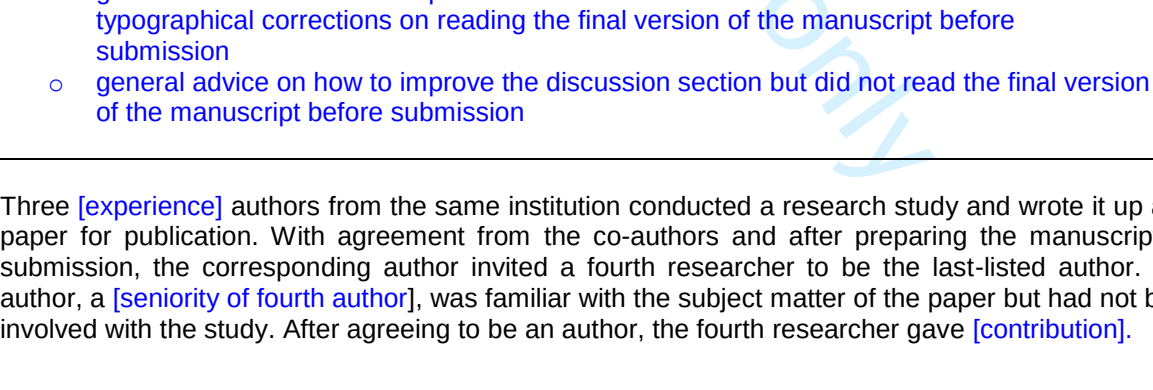


Scenario 4

Variables for randomisation
1. Experience:
   - senior experienced
   - junior inexperienced
2. Seniority of fourth author:
   - professor and head of department
   - junior inexperienced researcher who had not previously co-authored a research paper
3. Contribution:
   - general advice on how to improve the Discussion section and identified some typographical corrections on reading the final version of the manuscript before submission
   - general advice on how to improve the discussion section but did not read the final version of the manuscript before submission

Three [experience] authors from the same institution conducted a research study and wrote it up as a paper for publication. With agreement from the co-authors and after preparing the manuscript for submission, the corresponding author invited a fourth researcher to be the last-listed author. This author, a [seniority of fourth author], was familiar with the subject matter of the paper but had not been involved with the study. After agreeing to be an author, the fourth researcher gave [contribution].

On the scale of 0 to 10 below please rate how unethical you think the **corresponding author's** behaviour is:



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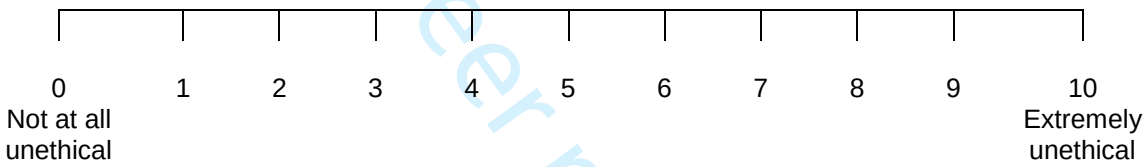
Scenario 5

Variables for randomisation:
1. Experience:
   - senior experienced
   - junior inexperienced
2. Length of conflict:
   - One year
   - Three years
3. Financial arrangement with company:
   - received a research grant from Company X in relation to a product discussed in the review article
   - received speaking fees from Company X for a lecture at a conference that included a discussion of a product included in the review article

A [experience] researcher submitted an unsolicited narrative review article to a medical journal. The article reviewed the treatment benefits of several major pharmaceutical products commonly used in the field. [Length of conflict] prior to this, the researcher [financial arrangement with company], but did not mention this on submission of the review.

On the scale of 0 to 10 below please rate how unethical you think this researcher's behaviour is:



SECTION 2

This section asks about your knowledge of specific publication issues. Please select the statement that best describes your knowledge of each of the seven topics.

1) **Self-plagiarism** is defined as the reuse or recycling of one's own previously published text, theories, images, data or tables usually without citation.

Please indicate your level of knowledge of self-plagiarism
- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

2) **Image manipulation** involves the modification of the originally captured image including the insertion or deletion of visual data.

Please indicate your level of knowledge of image manipulation:
- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

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3) **Plagiarism** constitutes the use of the words, theories, images or data of others without proper credit and involves the passing off of material as one's own.

Please indicate your level of knowledge of plagiarism:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

4) **Prior publication** involves the use of data, tables and images that have previously been made public, often in a setting other than a journal article.

Please indicate your level of knowledge of prior publication:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

5) **Authorship** is defined as the identification of an individual who has contributed significantly to the reported research and the composition of the paper. Many journals have adopted criteria that define what contributions constitute authorship.

Please indicate your level of knowledge about authorship:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

6) **Conflict of interest** has been defined as a set of conditions in which professional judgment concerning a primary interest, such as patient welfare or the validity of research, can be influenced by a secondary interest, such as personal or financial gain.

Please indicate your level of knowledge about conflict of interest:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

7) **Dual submission** is defined as the simultaneous submission of the same manuscript to more than one journal.

Please indicate your level of knowledge of dual submission:

- I have no knowledge of this topic
- I have some knowledge of this topic

I have substantial knowledge of this topic

SECTION 3

1) In which country do you mainly work?

2) In which country did you mainly train as a researcher?

3) Are you?

- Female
- Male

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4) What is your age? _____

5) What is your first (main) language?

- English
- Other (please specify): _____

6a) What is your clinical specialty?

OR

6b) Or if you are primarily an academic researcher, what is your research speciality? _____

7) For how many years have you been an active researcher?

- 1 – 2 years
- 3 – 5 years
- 6 – 10 years
- 11 – 15 years
- 16 – 20 years
- 21 – 25 years
- 26 - 30 years
- More than 30 years

8) Approximately how many research or review papers have you had published in journals (including papers that you have co-authored)? _____

9) On average, approximately how many journal articles do you peer review in a year? _____

10) Have you ever performed an editorial role, such as Editor in Chief or acted as an Editorial Board member?

- Yes
- No

11) How would you rate the quality of the training/guidance you have received on the ethics of publishing scientific research?

	Excellent	**Good**	**Average**	**Poor**	**I have never received this type of training/guidance**
From a scientific mentor					
A course you attended devoting some time to this topic					
A course you attended specifically on this topic					
Online resources on this topic					

Thank you for your help

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Biomedical Authors' awareness of publication ethics: An international survey

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Date Submitted by the Author:	03-Oct-2018
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Primary Subject Heading:	Ethics
Secondary Subject Heading:	Medical publishing and peer review
Keywords:	MEDICAL EDUCATION & TRAINING, MEDICAL ETHICS, ETHICS (see Medical Ethics)

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Biomedical Authors' awareness of publication ethics: An international survey

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Keywords: Publication ethics; vignettes; survey; plagiarism; authorship; conflict of interest; prior publication

Word count, abstract: 296

Word count, excluding title page, abstract, references, figures and tables: 4473

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Abstract

Objective

The extent to which biomedical authors have received training in publication ethics, and their attitudes and opinions about the ethical aspects of specific behaviours, have been under-studied. We sought to characterise the knowledge and attitudes of biomedical authors about common issues in publication ethics.

Design

Cross-sectional online survey.

Setting and participants

Corresponding authors of research submissions to 20 journals.

Main Outcome Measure(s)

Perceived level of unethical behaviour (rated 0 to 10) presented in five vignettes containing key variables that were experimentally manipulated on entry to the survey and perceived level of knowledge of seven ethical topics related to publishing (prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism).

Results

4043/10,582 (38%) researchers responded. Respondents worked in 100 countries and reported varying levels of publishing experience. 67% (n=2700) had received some publication ethics training from a mentor, 41% (n=1677) a partial course, 28% (n=1130) a full course, and 55% (n=2206) an online course; only a small proportion rated training received as excellent. There was a full 0 to 10-point range in ratings of the extent of unethical behaviour within each vignette, illustrating a broad range of opinion about the ethical acceptability of the behaviours evaluated, but these opinions were little altered by the context in which it occurred. Participants reported substantial variability in their perceived knowledge of 7 publication ethics topics; one-third perceived their knowledge to be less than "some knowledge" for the sum of the seven ethical topics and only 9% perceived "substantial knowledge" of all topics.

Conclusions

We found a large degree of variability in espoused training and perceived knowledge, and variability in views about how ethical or unethical scenarios were. Ethical standards need to be better articulated and taught to improve consistency of training across institutions and countries.

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Strengths and limitations of this study:

- Large survey providing a snapshot of author's awareness of publication ethics at a single point in time
- Included authors from a range of journals, disciplines, countries and with varying levels of research and publishing experience
- Responses were based on short hypothetical vignettes rather than personal experience

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Introduction

Many biomedical scientists report substantial pressure to produce numerous research publications, in part because the number of papers published is the main metric in most academic promotion systems. [1] In some cases, this pressure to publish may lead to ethical lapses, such as plagiarism, self-plagiarism (text recycling), ghost or honorary authorship, or failure to report competing interests. [2-7]

The increasing pressure to publish has not been matched with widespread training for researchers about ethical matters that are commonly encountered in the process of scientific publication. The Committee on Publication Ethics (COPE) provides such training for biomedical editors, but opportunities for biomedical researchers to learn about these ethical issues are not always available or required. If available, they often do not focus in-depth on such matters. [8] As with peer review, it may be assumed that researchers already have this knowledge or will learn on the job from mentors.

Previous research has identified considerable variation in knowledge and attitudes about publication ethics among biomedical scientists. For example, in one survey of 324 post-doctoral fellows a substantial proportion of respondents thought that being "head of the lab" or obtaining study funding were enough to qualify as an author on publications. [9] Around 20% of respondents reported that they had been unfairly omitted as an author. 38% of those who had been authors on previous publications reported that a co-author had not met authorship requirements.

Another study aimed to characterise professional norms regarding publication ethics among US grant-receiving scientists and research administrators. [10] This large study used a factorial vignette design. Virtually all respondents thought that fabrication, falsification, and plagiarism were unethical, but there was poor consensus regarding other behaviours such as making deliberately misleading statements about a paper, sloppiness, or failure to report conflicts of interest. Some research suggests that views about publication ethics may vary based on culture or scientific discipline. [11-13]

The goal of this study was to evaluate the prevalence and quality of formal training in publication ethics among biomedical authors, and to elicit their attitudes and opinions about specific behaviours. We define publication ethics as professional conduct that, in the words of COPE, “reflect[s] the current best principles of transparency and integrity.” We chose to focus on some of the topics emphasised by COPE in its educational activities for authors and editors. We aimed to study a large group of authors from diverse specialties and geographic locations. We also sought to determine whether views differed depending on level of research experience, location of training or practice, or specific mitigating or aggravating contextual circumstances that might be expected to alter perceptions about the seriousness of ethical lapses.

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Methods

Sample

Between 01 August and 30 September 2011, we surveyed corresponding authors of research submissions to 20 biomedical journals in a range of specialties published by the BMJ Publishing Group. The participating journals vary in terms of volume of research received, Impact Factor and acceptance rates. Contact information and other details of authors were obtained from the electronic manuscript tracking systems of each journal. All corresponding authors of research paper submissions in 2009 were eligible for inclusion in the study and participation was voluntary. We removed duplicate authors to ensure each author was invited only once.

Procedures

Eligible authors were sent a personalised email invitation to complete a survey regarding publication issues on an independent secure website. Authors were provided with a unique link tied to their email address. Only one set of responses was allowed per email address, but individuals were allowed to return to the survey to complete at a later time. As an incentive to participate, respondents were entered into a prize draw to win a donation of £500 to a choice of charities. Consent was implied by completion of the survey. Respondents were told that their responses would be treated confidentially and held on a secure server. They were also told that editors would not see named individual responses. Responses were stored using SSL encryption. Each invitation was tied to a unique email address and two reminders to complete the survey were sent to non-responders at approximately two weeks and two months after the initial mailing. We did not survey non-respondents to learn their reasons for nonresponse.

Questionnaire development and piloting

Questionnaire content and vignettes were developed from discussion with experts in publication ethics, and based on ethical problems encountered by BMJ editors and other members of the research team. The questionnaire was administered to four experts in publication ethics and two experts in survey design to confirm content validity and to check for ambiguous questions. It was then piloted with convenience samples of students and editorial assistants. We ran two further pilots (with 45 members of the editorial board of *Anesthesiology* and a sample of 100 submitting authors) to estimate response rate and burden. To reduce respondent burden, the questionnaire was shortened by reducing the complexity and number of vignettes based on these results.

Survey instrument

The questionnaire (Appendix 1) assessed the level of awareness of good publication practices. It had three sections: 1) vignettes describing a situation on a range of topics (prior publication, exclusion of an author, self-plagiarism, honorary authorship, and undeclared conflicts of interest); 2) questions about the respondent's perceived level of knowledge of seven ethical topics; and 3) questions about respondent characteristics. We developed customised survey software for this project so that we could randomise submitting authors to receive

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different presentations of the vignettes. We recorded the elapsed time completing the survey and present this data using median [25th, 75th]. Each vignette was presented on a single page followed by section 2 then 3 on separate pages. Respondent were not allowed to go back and changes their responses once completed as we did not want subsequent questions to influence earlier responses. Duplicate entries were avoided by preventing users access to the survey twice.

Vignettes

Respondents were shown a series of five vignettes. Each vignette was a short paragraph describing an ethical scenario (prior publication, author omission, self-plagiarism, honorary authorship, and undeclared conflicts of interest). There were several permutations of each vignette to determine the importance of mitigating or aggravating factors on perceptions of the seriousness of ethical lapses. Specifically, within each vignette there were three variables, each with two possible statements. Box 1 shows the five vignettes and the statements randomised within each. For example, within the vignette about self-plagiarism, respondents were randomised to rate a vignette that described a more or less experienced corresponding author, the presence or absence of a journal policy prohibiting self-plagiarism, and the type of previous publication of the plagiarised material (conference proceedings or abstract at a meeting).

Participants were randomised to receive different combinations of possible statements for each vignette. They were asked to rate how unethical they thought the researcher's behaviour was on a numerical rating scale (0=Not at all unethical, 10=Extremely unethical), similar to that used in a previous study. [8] With the exception of the prior publication vignette, which described a situation that was not considered unethical and was always presented first, the vignettes were selected and presented at random on entry to the survey. Each vignette was presented on its own page and respondents were not allowed to return to a vignette and change their ratings after moving to the next page.

Perceived knowledge

Respondents were given a short definition of seven ethical topics and asked to indicate their level of knowledge (0=no knowledge, 1=some knowledge, 2=substantial knowledge) of each topic: prior publication, author omission, self-plagiarism, honorary authorship, conflicts of interest, image manipulation and plagiarism.

Respondent characteristics

Participants were asked their gender, age, work specialty, country of work, country of training, number of years spent as an active researcher, number of research papers published, number of articles they peer review each year, whether they had performed editorial roles, and to rate the perceived quality of the training or guidance they had received on the ethics of publishing scientific research.

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Statistical analysis

All responses were automatically captured by the survey software. All statistical analyses were conducted blinded to the identities of the respondents. Prior to the analysis the data were inspected for completeness and accuracy. Missing data were examined based on participant and response characteristics. All available data were used for the analysis and all reported analyses were pre-specified. Descriptive statistics for the other measurements were reported based on the nature of the underlying data: medians [25th, 75th percentile] are used for data with at least ordinal properties and frequency counts (%) are used for categorical data.

We compared respondents with non-respondents by country in which they were based, the journal to which they submitted, and whether the paper they had submitted to the journal was peer reviewed or not. Correlations between items were estimated using Kendall's Tau correlation to account for ties in the ordinal scales. Comparisons for categorical data were conducted using chi-squared tests. The primary analysis was conducted for each vignette using several generalized linear models with perceived 'unethicalness' as the outcome variable and randomised condition as the predictors. This resulted in a fully crossed design where all combinations of conditions in Box 1 were presented across participants (each participant completed only one version of each vignette). For the models, the three between-subjects categorical main effects for each condition were entered along with all two-way interactions and a three-way interaction. Higher order interactions were interpreted such that combinations of the randomised conditions induced differences in unethicalness scores that were conditional on the levels of the other conditions. The rank order of presentation of each vignette was adjusted as an additional covariate to control for order effects. Where appropriate, all analyses are two-tailed and statistical significance is inferred for $p < 0.05$. We did not adjust for multiple comparisons. R statistical software (R Core Team, 2012) was used for all analyses. [14]

Patient and Public Involvement

We did not include patients as study participants. Patients were not involved in setting the research question, designing the study, the conduct of the study, or the interpretation of the results.

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Results

Respondent characteristics

After correcting for delivery failures, 10,582 people were sent an invitation. 4,043/10582 (38%) completed at least some of the survey. Of those responding 3,090 (76%) completed the entire survey, 3,668 (91%) rated at least one vignette. Having an article peer reviewed (34.5%) versus not peer reviewed (33.7%) was not related to the response rate, p = 0.339. For those who completed the entire questionnaire, the median time to complete was 8 [5, 12] minutes.

Respondents reported they worked in 101 countries. Figure 1 displays the number of responses received based on country of work for the top 20 contributing countries. Of the countries that had greater than n=100 individuals who were sent surveys, the likelihood of surveys being returned varied widely between countries. For example, 53/102 (51.9%) of individuals from New Zealand returned surveys, while only 34/194 (17.5%) of individuals from Korea returned surveys. The three countries with the highest response rates were New Zealand (51.9%), Norway (45.9%), and Sweden (44.5%). The three countries with the lowest response rates were Korea (17.5%), unreported country (26.0%), and Finland (26.8%).

Respondents had a median [25th, 75th] age of 44 [37, 52], almost half reported their main language was not English, and 30% were female and 50% male (Table 1). Roughly 17% of the 3,222 respondents who disclosed their country of training and country of work reported that they received postgraduate education in a country that was different to their current country of work. Respondents ranged in research experience; 254 (6%) had less than 10 years of experience and 510 (13%) had over 25 years. Respondents completed a median of 5 [2, 10] peer reviews a year and had published a median of 30 [10, 70] articles in their career. 1073 (26.5%) of the respondents reported serving on at least one journal editorial board.

Perceived Knowledge of Publication Ethics

Participants reported substantial variability in the perception of their own knowledge about seven ethical topics (Table 2). Substantial knowledge in the seven topics ranged from 21.3% for author omission to 60.5% for conflicts of interest. Participants' scores on each of the seven domains of perceived knowledge were only moderately correlated (r = 0.21 to 0.50, p's < 0.001; Table 2). The individual items were summed to create a total score, which demonstrated good internal consistency ($\alpha = 0.84$ and item-total correlations <0.30). Perceived knowledge on one domain was a good predictor of how a participant perceived their overall knowledge of these issues. One-third (33.7%) of the participants perceived their knowledge to be less than "some knowledge" for the sum of the seven listed ethical topics. Only 8.8% of participants indicated that they possessed "substantial knowledge" on all seven topics.

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Training in Publication Ethics

Training from a mentor was the highest rated source, with 43% of the sample reporting perceiving at least a "good" or "excellent" level of training from a research mentor (Table 3). Formal training was less common, with 51% of respondents reporting they have never participated in a full course on publication ethics, and less than half (42%) reporting receipt of some ethical training in partial coursework. The most commonly reported source of training was online courses, with 55% of the sample reporting this type of experience, but only 31% rated the quality of this online training as "good" or "excellent".

Perceived quality of previous training was positively associated (phi =0.45, p<0.001) with perceived knowledge scores, indicating that individuals with higher levels of perceived quality of previous training endorsed higher perceptions of knowledge about ethical issues. To estimate this association, we coded each respondent's highest perceived quality rating from any of their previous training sources, and estimated an association with their perceived knowledge total score. The highest score was used because it was not expected that participants would receive training from all sources and high levels of perceived quality from any single source could impact perceived knowledge.

Vignettes

Figures 2-6 display the unethical ratings for each vignette as a function of the experimental manipulations using violin plots. Each one of the experimental conditions (x-axis) is plotted using the smoothed frequency of responses by unethical rating (y-axis). The width of the plot at each rating corresponds to the relative frequency of responses for that rating. The p-values reported in the text below were generated using the linear mixed model described in the statistical analysis section. This approach contrasts the fixed-effects (i.e. experimental conditions) to generate point estimates of the difference between conditions, 95%CI around these differences, and p-values for this contrast.

As can be observed in the plots, a great deal of variability was observed for all vignettes with all conditions exhibiting the full range of possible responses (0 to 10 scores). There were no higher-order interactions among the experimental manipulations for any of the vignettes, allowing main effects to be interpreted. For all except the conflict of interest vignette (p=0.006), the level of experience of the researcher described did not significantly influence responses (p>0.05). Findings for each vignette are presented below.

Prior publication

For this vignette, the experimental manipulations accounted for a statistically significant (p < 0.0001), though only small amount (6.4%), of the total variability in responses. If the journal had a policy about previous publication, the behaviour described in the vignette was rated as 0.38 points (95%CI: 0.16 to 0.60, p = 0.0006) more unethical than if the journal did not possess a policy (Figure 2). If the previous submission was published

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in proceedings from a conference, the behaviour was rated as 1.68 points (95%CI: 1.46 to 1.89, $p < 0.0001$) more unethical than if it were only previously reported as an abstract.

Author omission

The experimental manipulations accounted for only 16% of the total variability in responses ($p < 0.0001$),. The order in which this vignette was presented to respondents influenced ethical ratings of the behaviour it described. Respondents who viewed the vignette later rated the behaviour it described as -0.18 points less unethical for each previous vignette encountered. The time elapsed since contact was lost with the author influenced ratings of the vignettes with 6 months elapsed rated as -0.64 points (95%CI: -0.84 to -0.45., $p < 0.0001$) less unethical than if only 1 month had elapsed (Figure 3). If the missing author was formally acknowledged, the practice was rated as - 2.45 points (95%CI: -2.64 to -2.26, $p < 0.0001$) less unethical than if they were not acknowledged.

Self-plagiarism

The experimental manipulations accounted for only 1.5% of the total variability in responses ($p < 0.0001$). The order in which the vignette was presented did not influence ratings ($p = 0.71$). The quantity of self-plagiarised material did influence ratings of the behaviour described in the vignette, with 35% of the material being plagiarised rated as 0.61 points (95%CI: 0.42 to 0.80, $p < 0.0001$) more unethical than if only 10% had been plagiarised (Figure 4). If the plagiarised sections included the literature interpretation, the practice was rated as 0.30 points (95%CI: 0.11 to 0.49, $p = 0.002$) more unethical than if only the literature search strategy was plagiarised.

Honorary authorship

The experimental manipulations accounted for only 8.2% of the total variability in responses ($p < 0.0001$). The randomised order in which this vignette was presented to respondents did influence ethical ratings of the behaviour it described. Those who viewed the vignette later rated behaviour as -0.14 points less unethical for each previous vignette encountered.

The experience of the researcher did not influence responses, with distinctions between senior and junior researchers accounting for only 0.11 points on a 10-point unethical scale (95%CI: -0.08 to 0.30, $p = 0.08$) (Figure 5). However, the seniority of the added author did influence ratings, with added junior authors (submitting their first paper) rated as 0.64 points (95%CI: 0.45 to 0.82, $p < 0.0001$) more unethical than added senior professors (heads of department). If the contribution of the added author included a careful reading of the manuscript (e.g. correcting typographical errors) as well as advice, the practice was rated as -1.51 points (95%CI: -1.70 to -1.32, $p < 0.0001$) less unethical than if only general advice was offered without a careful reading of the manuscript.

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Conflicts of interest

The experimental manipulations accounted for only 4.2% of the total variability in responses ($p < 0.0001$). The randomised order in which this vignette was presented to respondents affected ethical ratings, with later viewings rating the described behaviour as 0.19 points more unethical for each previous vignette encountered.

The experience of the researcher did influence responses, with distinctions between senior and junior researchers accounting for -0.28 points on a 10-point unethical scale (95%CI: -0.45 to -0.12, $p = 0.0006$) (Figure 6). The duration elapsed since the conflict of interest influenced ratings of the vignettes; 3 years since the conflict was rated as -0.35 points (95%CI: -0.52 to -0.19, $p < 0.0001$) less unethical than if the conflict was more recent (1 year). If the conflict of interest consisted of receiving speaking fees, the practice was rated as -0.93 points (95%CI: -1.10 to -0.77, $p < 0.0001$) less unethical than if a research grant was involved.

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Discussion

Only a small minority of biomedical researchers reported a substantial level of knowledge about the ethical matters evaluated in this study. Most had not had a full course of formal training in publication ethics. Instead, informal training from mentors, who themselves possibly had not received formal training, was common. Our results are consistent with studies done several decades ago that found low levels of training in research ethics among graduate students and postdoctoral fellows. Three studies in the 1990s reported low levels of training or guidance in research ethics among students from the US. [9, 15, 16]

Although individual respondents clearly distinguish among publication practices that are more or less ethical, there is a striking lack of consensus on many matters, especially self-plagiarism and inappropriate authorship. Prior work suggests that opinions on these two topics vary considerably. [17, 18] The lack of agreement about the seriousness of the topics presented might reflect either unreliability of the assessment paradigm or true disagreement among respondents regarding the behaviour that is described. Since most respondents did not receive what they considered to be good ethical training, the latter seems most likely. In the absence of formal, standardised training in publication ethics, respondents presumably relied on their own experience and beliefs to determine whether and to what extent something was unethical.

In a previous study, conflicts of interest were condemned most strongly when there was failure to disclose a financial interest, and deliberate plagiarism was judged more harshly than when it was unintentional. [10] We thus tested several versions of each of our vignettes to see whether there were specific circumstances that altered judgments about the ethical appropriateness of each behaviour. For example, junior faculty report that they feel an obligation to add guest authors to papers if that person is an administrative superior. [19] It seemed reasonable to expect that being a junior rather than a senior researcher might cause respondents to view an ethical lapse as less serious. To our surprise, however, this was not the case, a finding that replicates previous work showing that sex and academic seniority of a scientist did not affect malfeasance ratings. [10]

This was also true for the other altered variables. More than 84% of the variance in ethical ratings was unrelated to the experimental manipulations within the vignettes; these accounted for only 1.5% to 16% of the variance in ethical ratings. This suggests that although there is a broad range of opinion about the ethical acceptability of the behaviours we evaluated, these opinions are little altered by the context in which it occurs. In other words, at least among our sample of active biomedical researchers, respondents appear to judge certain behaviours to be intrinsically ethical or not.

Strengths and limitations

Our study has a number of strengths. It is the largest survey of its kind, with over 3000 responses from active researchers submitting research papers to a range of peer-reviewed specialty journals and a general medical journal. We included authors who had received both rejection and acceptance decisions so that the sample

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would be representative of researchers in general, not just those who succeeded in publishing in the selected journals. The survey also includes responses from researchers who have worked and trained in a large number of countries and institutions. This is in contrast to previous surveys that have been smaller or have focused on a single country, discipline or institution. [9, 10, 15, 16]

Our study also has a number of limitations. The response rate of 38% is low. It is possible that the complexity of the survey or the sensitive nature of the topic discouraged some participants. It is also possible that institutional spam filters prevented our emails from reaching respondents. However, physician responses to web surveys are known to be declining and the response rate to our survey is similar to that reported in a large survey of doctors [20] and higher than that of a large survey of international authors on attitudes to peer review in 2009 [21] Additionally, the response rate to this survey is in the same range as other surveys on this sensitive topic, which have ranged from 27 to 33%. [9, 16, 22]

Although we observed some order effects, these were small and the randomised order of vignette presentation makes it unlikely this has produced any bias in our results. The journals in our study are all published by the BMJ Publishing Group and are relatively high profile journals with a strong commitment to ethical standards. At the time of the survey, many of these journals provided guidance about matters of publication ethics on their website or during the submission process. This might have affected author awareness and views about some of the behaviours that we studied. Thus, our results may not be generalisable to authors submitting to other journals. Response bias, in any variety of forms, is always of concern in a survey study of this type. Although we could examine several obvious sources of responder bias (e.g. author experiences in submission), we took great care in blinding participant identities to best ensure anonymity, so we could not collect extensive information on non-responders for the purposes of comparison with responders.

Although we piloted and revised the vignettes based on feedback, it remains possible that respondents might not have interpreted them as intended.

Study Implications

Our study of a diverse group of biomedical researchers shows that the prevalence of formal training in publication ethics is low, and when training is received it is often perceived to be of low quality. Although it is tempting to suggest that efforts are needed to improve the availability of formal training in publication ethics, such action may be premature. The authors of a recent Cochrane review evaluating the effectiveness of educational or policy interventions addressing research integrity and responsible conduct of research concluded that the effectiveness of these interventions on reducing misconduct is uncertain owing to the very low quality of the available evidence. [23] There is a surprising lack of consensus among researchers about the ethical seriousness of behaviours that many experts consider to be inappropriate, although even experts do not always agree. [24]

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Readily available, standardised training might help, but first we need to understand the reasons for these divergent views to design effective instruction. Once this is done, a strong case can be made that educational efforts should begin with medical journal editors and senior researchers, rather than those who are more junior. The rapid growth of the Committee of Publication Ethics (COPE) from a handful of editors fifteen years ago to a current membership of thousands illustrates the desire of editors for guidance on ethical matters. Both COPE and the World Association of Medical Editors (WAME) provide online guidance intended principally for journal editors and publishers. Despite this, even editors of major medical journals, the majority of whom report having had training about editorial responsibilities, have shown poor knowledge of many ethical matters that are commonly encountered in scientific publishing. [25]

Perhaps because of this deficient training and knowledge among editors, medical journals do not always have policies or provide clear or consistent ethical guidance to authors. [26] Some journals have policies based on guidance from COPE but have developed their own standards regarding specific matters such as authorship. [27] Amongst those titles with policies, there are frequently differences in the interpretation and execution of ethical standards. [28]

Perhaps the most practical starting point would be to work harder to identify core ethical matters about which there is little disagreement, while leaving individual journals to develop and impose their own standards about things for which there is less consensus. The biomedical community has a responsibility to articulate and enforce standards of publication ethics in order to maintain public trust in research.

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Competing interests

SS is a full-time employee of the BMJ Publishing Group and has access to all submission data and regularly undertakes research with its authors and reviewers. SM is a former employee of BMJ Publishing Group. EL receives salary support from *The BMJ* for her services as head of research. This is paid to her employing institution (the Brigham and Women's Physician Organization). None of the authors work directly for BMJ Open or are involved in the decision-making process for articles submitted to BMJ Open. This paper was sent out for peer review in the usual way and treated in the same way as all submissions to the journal. TH, JR, DP have no relevant conflicts of interest.

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Ethics

We submitted our research proposal to the BMJ Ethics Committee for comment. They did not have any specific ethical concerns about the study design. The research committee of the Committee on Publication Ethics (COPE), which funded the study, also approved the study protocol. Editors of participating journals gave their consent for the study.

Contributorship

All authors (SS, JR, EL, DP, SM, TH) contributed to the design of the study and the survey tool, were involved in regular steering group meetings, and critically reviewed the manuscript and approved the final version before submission. SS, TH and JR wrote the first draft of this manuscript. EL revised the manuscript and reference list and solicited comments from other authors. JR took the lead on reviewing the literature. SS and SM gathered the sample of authors. SS piloted the survey with students and experts. SS managed email responses and bouncebacks to the survey. TH conducted all statistical analysis and was blinded to the respondents' identities and signed a confidentiality statement for the BMJ. All authors (SS, JR, EL, DP, SM, TH) helped interpret the findings and approved the final version of the manuscript for publication.

Data Sharing Statement

Data are available upon reasonable request.

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Table 1: Respondent characteristics for those completing at least some of the questionnaire (n=4043)

Characteristic	All respondents (n=4,043)
Median [25th, 75th] age in years (n)	44 [37, 52] n=3214
Sex, n (%)	
Male	2030 (50.2%)
Female	1202 (29.7%)
Missing	811 (20.1%)
Previous experience in an editorial role , n (%)	
No	2168 (53.6%)
Yes	1073 (26.5%)
Missing	802 (19.8%)
First (main language), n (%)	
English	1250 (30.9%)
Other	1915 (47.4%)
Missing	878 (21.7%)
Years of research experience	
1 to 2 years	148 (3.6%)†
3 to 5 years	106 (2.6%)
6 to 10 years	587 (14.5%)
11 to 15 years	802 (19.8%)
16 to 20 years	591 (14.6%)
21 to 25 years	421 (10.4%)
26 to 30 years	298 (7.4%)
> 30 years	212 (5.2%)
Missing	878 (21.7%)
Median [25th, 75th] number of peer reviews conducted annually (n)	5 [2, 10] (n=3258)
Median [25th, 75th] number of papers published (n)	30 [10, 70] (n=3271)

Note: Not all percentages sum to 100% due to rounding.
Figures are numbers (percent) unless indicated otherwise.

† Due to a computer coding mistake, this value was stored with missing values and was imputed using deterministic methods (i.e., the value was deduced by examining the other responses).

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Table 2: Respondents self-perceived level of knowledge of seven publication ethics topics

Topic	Number completing each question	Perceived knowledge n (%)*			Kendall's Tau correlation						
		None	Some	Substantial	PP	AO	SP	HA	CI	IM	P
Prior publication (PP)	3360	489 (14.6)	1886 (56.1)	985 (29.3)	-						
Author omission (AO)	3363	1265 (37.6)	1380 (41.0)	718 (21.3)	0.36	-					
Self-plagiarism (SP)	3362	227 (6.8)	1409 (41.9)	1726 (51.3)	0.49	0.31	-				
Honorary authorship (HA)	3361	283 (8.4)	2014 (59.9)	1064 (31.7)	0.45	0.36	0.46	-			
Conflicts of interest (CI)	3361	77 (2.3)	1251 (37.2)	2033 (60.5)	0.33	0.21	0.46	0.40	-		
Image manipulation (IM)	3362	125 (3.7)	1456 (43.3)	1781 (53.0)	0.38	0.28	0.48	0.41	0.46	-	
Plagiarism (P)	3364	512 (15.2)	1268 (37.7)	1584 (47.1)	0.45	0.38	0.50	0.43	0.38	0.45	-

* Reported as a proportion of the number who completed each item.

All correlations $p < 0.0001$.

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Table 3: Receipt of and perceived quality of ethical training (n=4043)

		Perceived quality of training received*				
Type of training/guidance	**Not received**	**Poor quality**	**Average quality**	**Good quality**	**Excellent quality**	**Missing data**
Ethical training from a mentor	535 (13.2)	232 (5.7)	718 (17.8)	1146 (28.3)	604 (14.9)	808 (19.9)
Ethical guidance: partial course	1526 (37.7)	156 (3.9)	566 (14.0)	766 (18.9)	189 (4.7)	840 (20.8)
Ethical guidance: full course	2053 (50.7)	117 (2.9)	332 (8.2)	487 (12.0)	194 (4.8)	860 (21.2)
Ethical guidance: self training through online resources	989 (24.5)	164 (4.1)	796 (19.7)	1007 (24.9)	239 (5.9)	848 (21.0)

Note: Percentages do not sum to 100% due to rounding.

*Measured on a 4-point Likert scale (0=poor quality, 1=average quality, 3=good quality, 4=excellent quality).

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Box 1: List of variables randomised within each vignette

Topic	Vignette	Variable for randomisation	Statements varied
Prior publication	A [experience] researcher submitted a manuscript describing the primary results of a study to a medical journal that [journal policy]. A peer reviewer comments that the same study results have already been published [How the study had previously been reported] and that this prior publication means the work is not new and should not be considered for publication by the journal.	Experience	• senior experienced • junior inexperienced
		Journal policy	• prohibits the submission of work that has previously been published • has no policy regarding the submission of work that has previously been published
		Previous reporting of study	• in an abstract at a professional meeting • as a paper in the proceedings from a conference
Authorship omission	A corresponding author, a [experience] member of staff, is ready to submit a manuscript. A research student, helped with the design of the study, data collection, and writing of the manuscript, but has since relocated and cannot be reached to provide final approval of the manuscript. After trying to contact the research student for [time], the corresponding author decides to remove the student's name from the paper, [level of recognition] and publishes the paper.	Experience	• senior experienced • junior inexperienced
		Time	• 1 month • 6 months
		Level of recognition	• recognises their contribution in the Acknowledgements section instead • does not mention the student's contributions in the Acknowledgements section
Self-plagiarism	A [experience] author submitted a systematic review article to Journal X. A peer reviewer commented that parts of the paper reproduced work previously published by the same author in a textbook chapter. The reviewer claimed that about [quantity] of the text, mainly [material], appeared to be identical without any reference to the textbook chapter.	Experience	• senior experienced • junior inexperienced
		Quantity of overlapping material	• 10% • 35%
		Material	• in the Introduction section and the Methods describing the literature search strategy • describing the interpretation of the literature

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Topic	Vignette	Variable for randomisation	Statements varied
Honorary authorship	Three [experience] authors from the same institution conducted a research study and wrote it up as a paper for publication. With agreement from the co-authors and after preparing the manuscript for submission, the corresponding author invited a fourth researcher to be the last-listed author. This author, a [seniority of fourth author], was familiar with the subject matter of the paper but had not been involved with the study. After agreeing to be an author, the fourth researcher gave [contribution].	Experience	• senior experienced • junior inexperienced
		Seniority of fourth author	• professor and head of department • junior inexperienced researcher who had not previously co-authored a research paper
		Contribution	• general advice on how to improve the Discussion section and identified some typographical corrections on reading the final version of the manuscript before submission • general advice on how to improve the Discussion section but did not read the final version of the manuscript before submission
Conflict of interest	A [experience] researcher submitted an unsolicited narrative review article to a medical journal. The article reviewed the treatment benefits of several major pharmaceutical products commonly used in the field. [Length of conflict] prior to this, the researcher [financial arrangement with company], but did not mention this on submission of the review.	Experience	• senior experienced • junior inexperienced
		Length of conflict	• One year • Three years
		Financial arrangement with company	• received a research grant from Company X in relation to a product discussed in the review article • received speaking fees from Company X for a lecture at a conference that included a discussion of a product included in the review article

Notes: The name of the variable that was randomised is included in square brackets in the second column and the actual statements randomised are in the fourth column.

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Figure legends

Figure 1: Responses by country of work for the top 20 contributing countries
Figure 2: Prior publication vignette response
Figure 3: Author omission vignette response
Figure 4: Self-plagiarism vignette response
Figure 5: Honorary authorship vignette response
Figure 6: Conflicts of interest vignette response

Appendix 1: Study questionnaire

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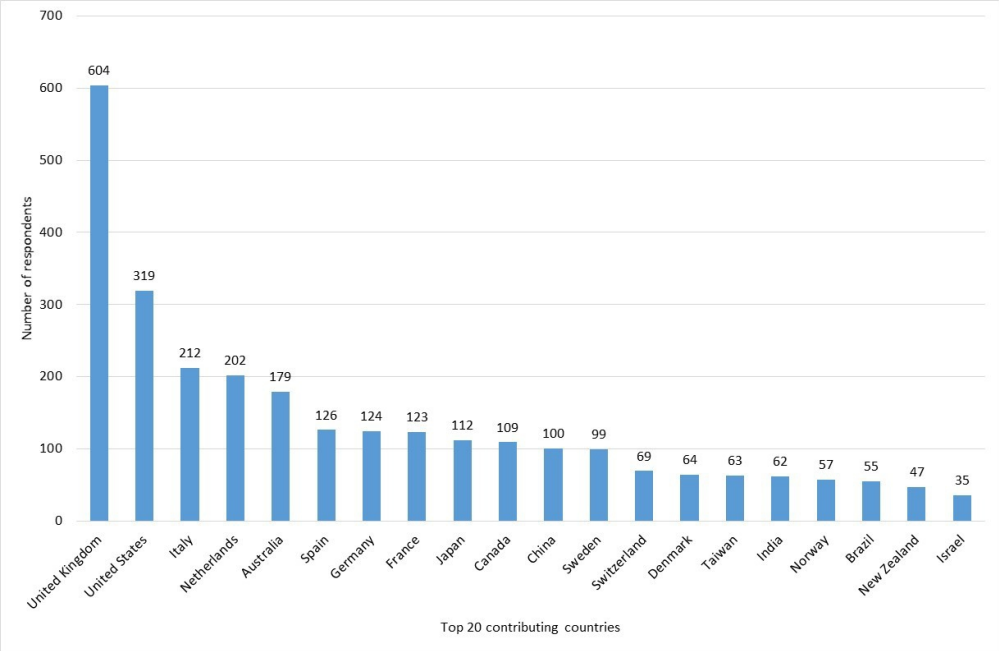

Figure 1: Responses by country of work for the top 20 contributing countries

258x168mm (120 x 120 DPI)

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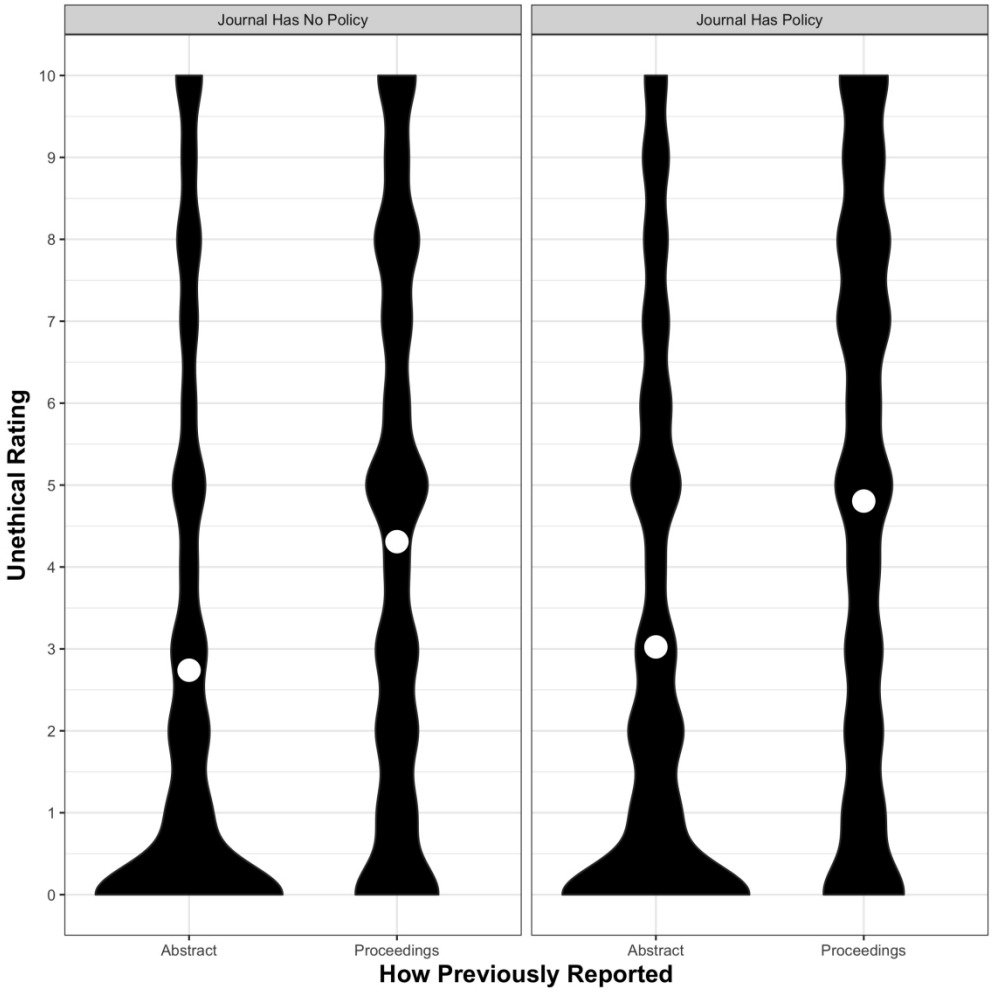

Figure 2: Prior publication vignette response

846x846mm (72 x 72 DPI)

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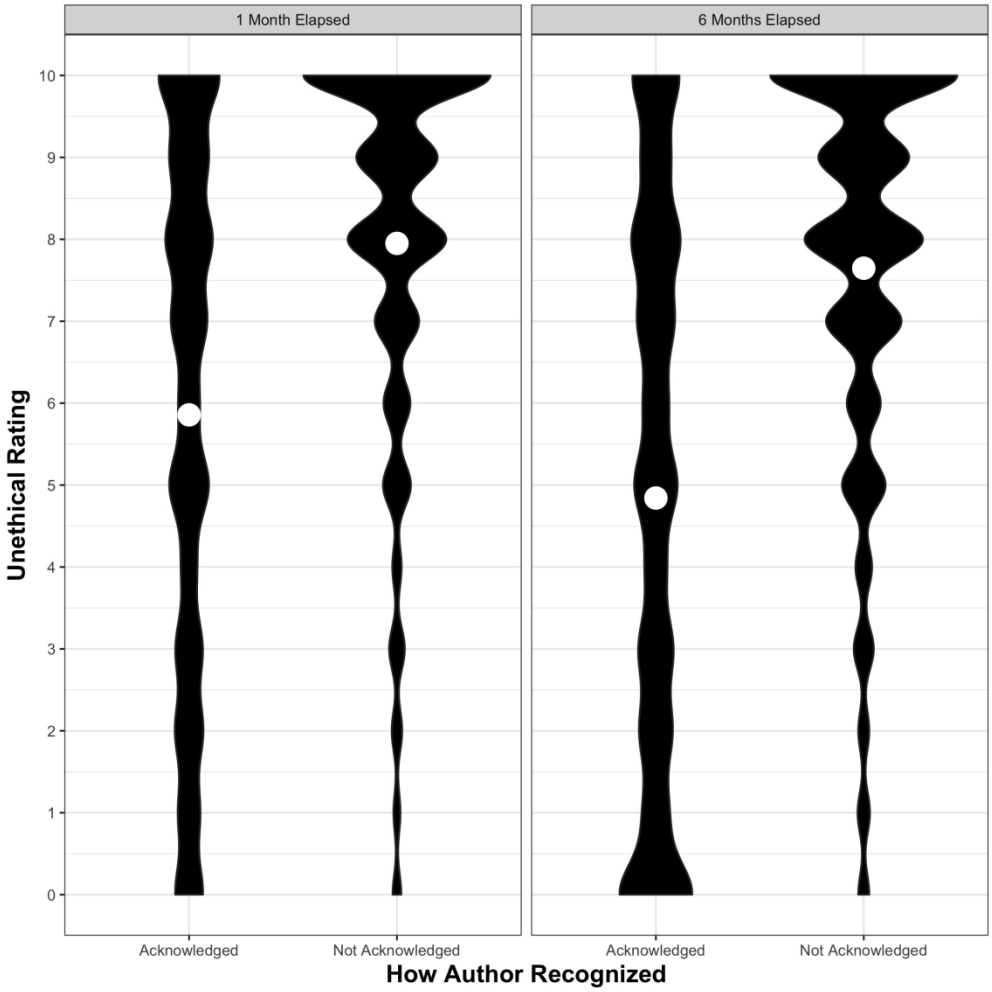

Figure 3: Author omission vignette response

846x846mm (72 x 72 DPI)

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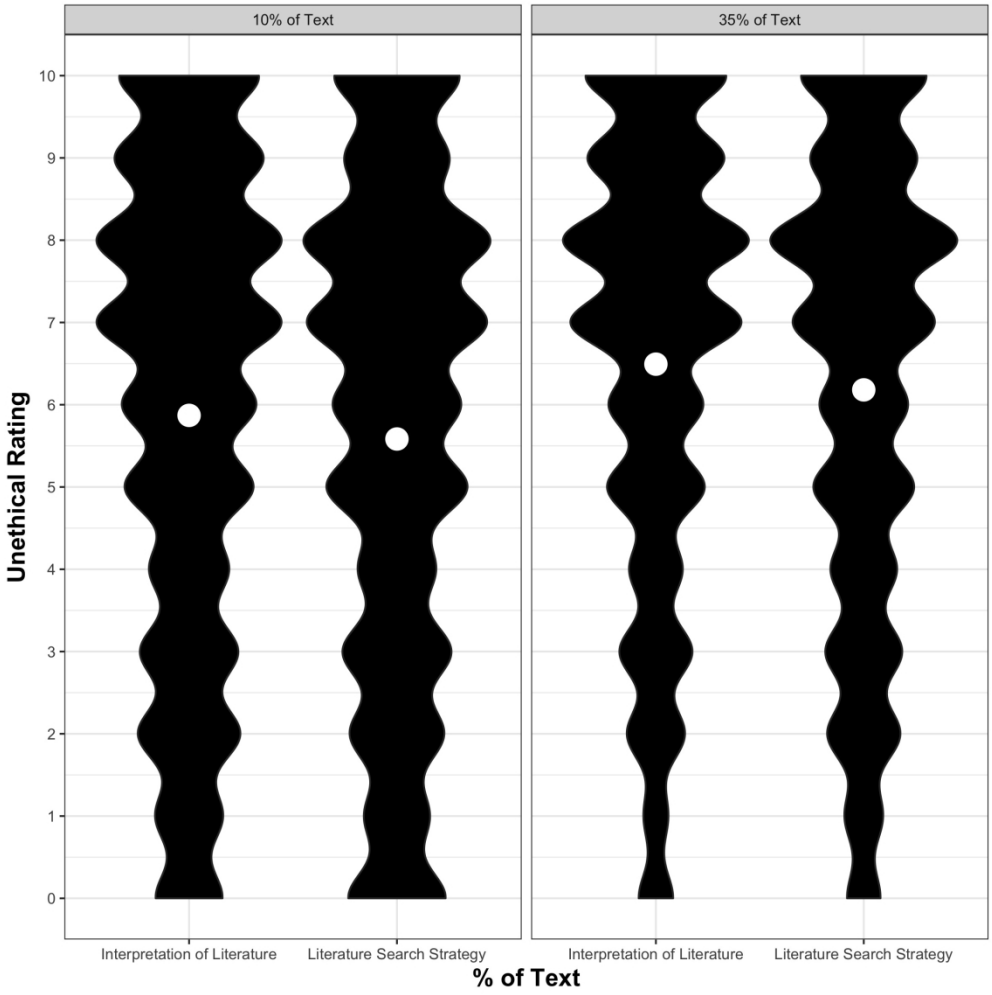

Figure 4: Self-plagiarism vignette response

846x846mm (72 x 72 DPI)

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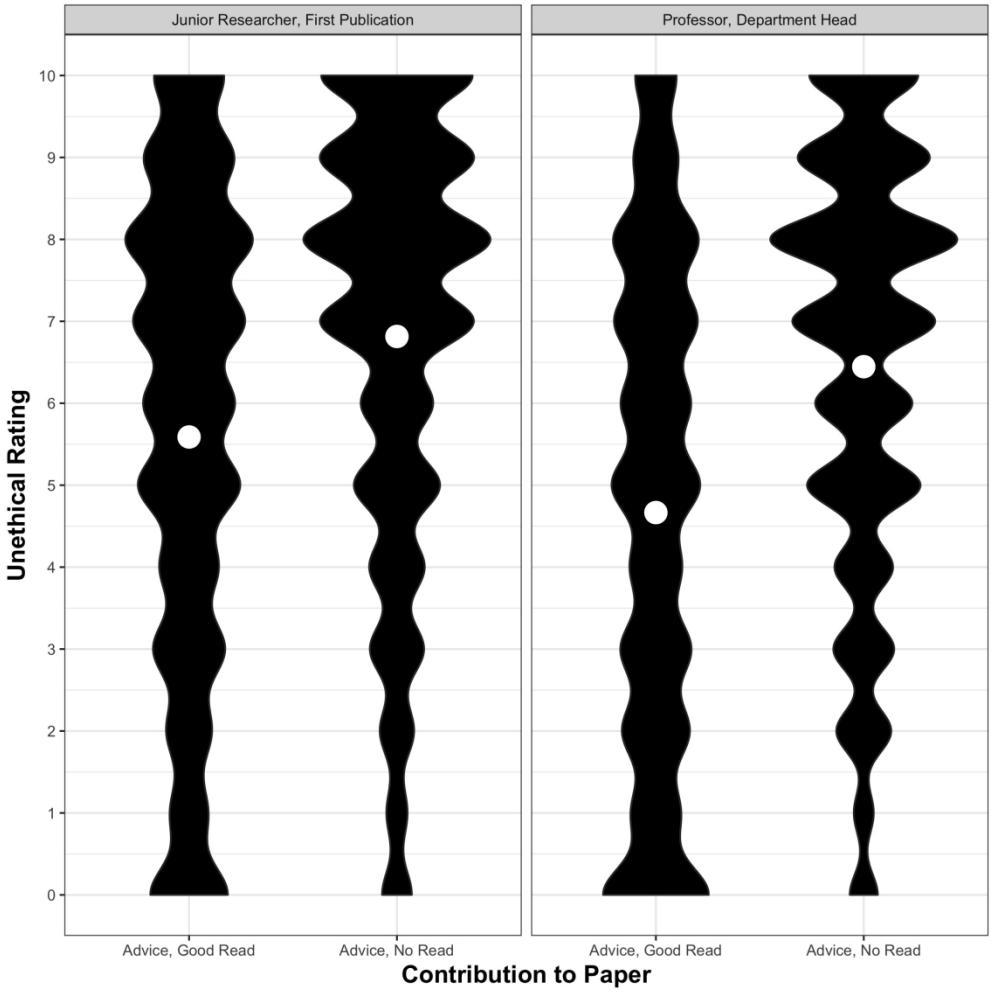

Figure 5: Honorary authorship vignette response

846x846mm (72 x 72 DPI)

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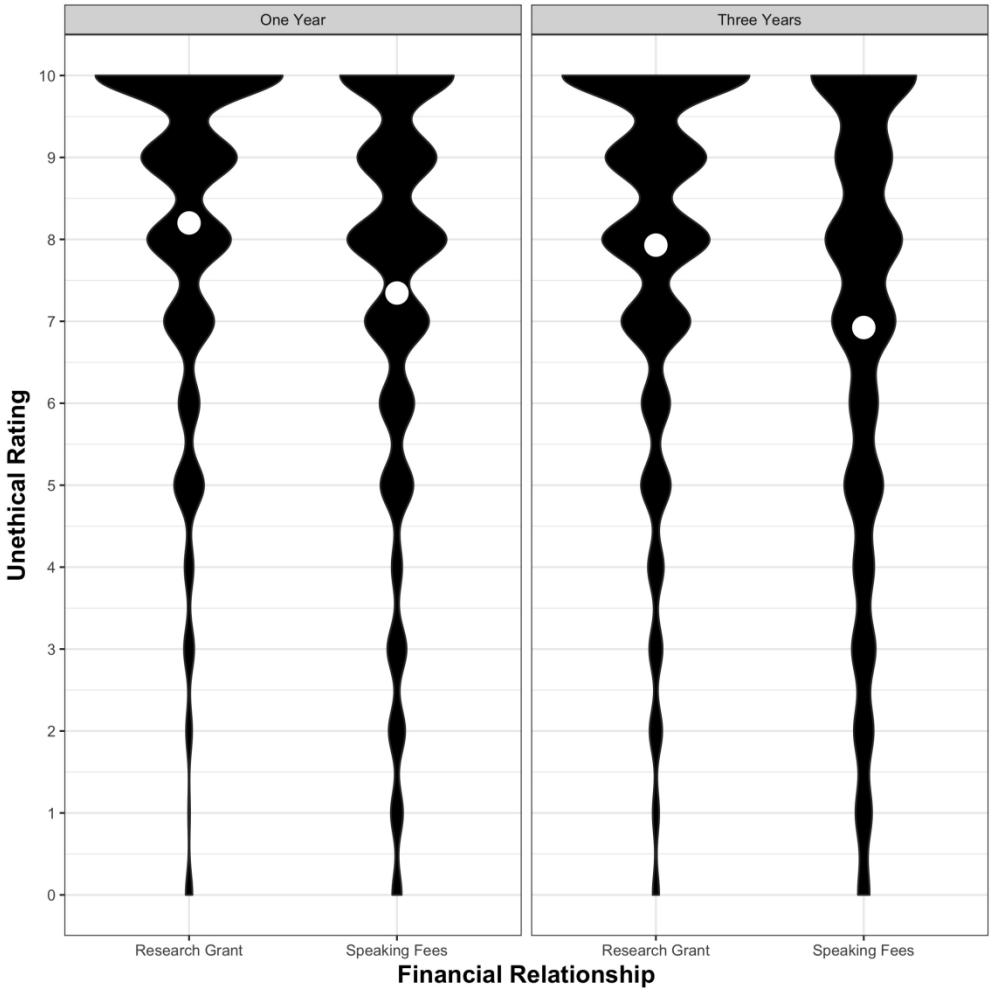

Figure 6: Conflicts of interest vignette response

846x846mm (72 x 72 DPI)

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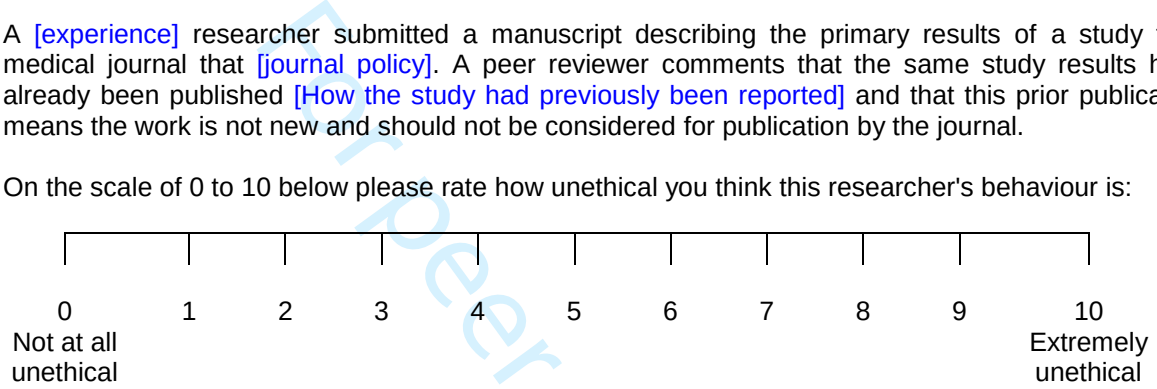
SECTION 1

Scenario 1

Variables for randomisation:
1. Experience
   - senior experienced
   - junior inexperienced
2. Journal policy
   - prohibits the submission of work that has previously been published
   - has no policy regarding the submission of work that has previously been published
3. How the study had previously been reported
   - in an abstract at a professional meeting
   - as a paper in the proceedings from a conference

A [experience] researcher submitted a manuscript describing the primary results of a study to a medical journal that [journal policy]. A peer reviewer comments that the same study results have already been published [How the study had previously been reported] and that this prior publication means the work is not new and should not be considered for publication by the journal.

On the scale of 0 to 10 below please rate how unethical you think this researcher's behaviour is:

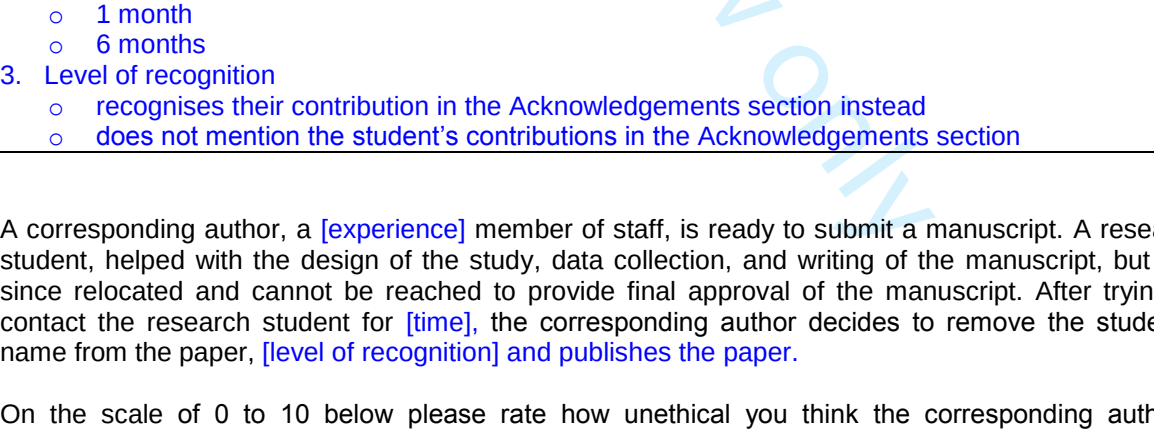


Scenario 2

Variables for randomisation
1. Experience
   - senior experienced
   - junior inexperienced
2. Time
   - 1 month
   - 6 months
3. Level of recognition
   - recognises their contribution in the Acknowledgements section instead
   - does not mention the student's contributions in the Acknowledgements section

A corresponding author, a [experience] member of staff, is ready to submit a manuscript. A research student, helped with the design of the study, data collection, and writing of the manuscript, but has since relocated and cannot be reached to provide final approval of the manuscript. After trying to contact the research student for [time], the corresponding author decides to remove the student's name from the paper, [level of recognition] and publishes the paper.

On the scale of 0 to 10 below please rate how unethical you think the corresponding author's behaviour is:



Scenario 3

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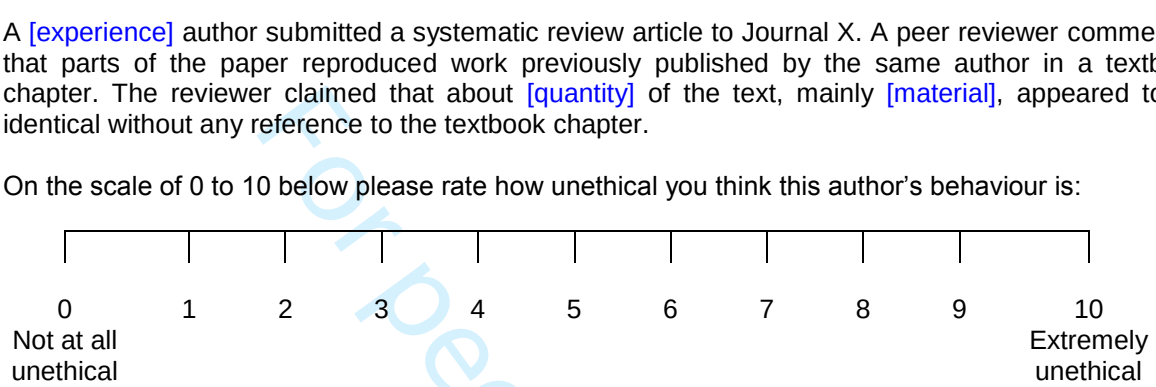
Variables for randomisation:
1. Experience
   - senior experienced
   - junior inexperienced
2. Quantity of overlapping material
   - 10%
   - 35%
3. Material
   - in the Introduction section and the Methods describing the literature search strategy
   - describing the interpretation of the literature

A [experience] author submitted a systematic review article to Journal X. A peer reviewer commented that parts of the paper reproduced work previously published by the same author in a textbook chapter. The reviewer claimed that about [quantity] of the text, mainly [material], appeared to be identical without any reference to the textbook chapter.

On the scale of 0 to 10 below please rate how unethical you think this author's behaviour is:

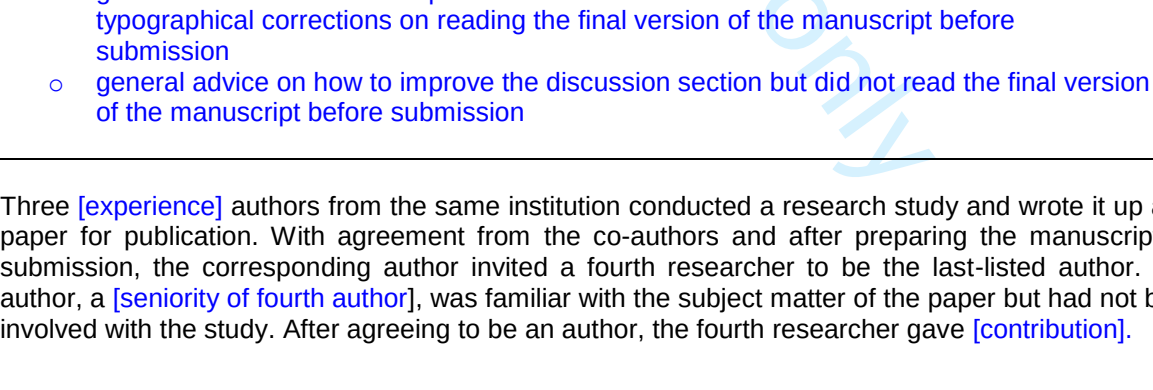


Scenario 4

Variables for randomisation
1. Experience:
   - senior experienced
   - junior inexperienced
2. Seniority of fourth author:
   - professor and head of department
   - junior inexperienced researcher who had not previously co-authored a research paper
3. Contribution:
   - general advice on how to improve the Discussion section and identified some typographical corrections on reading the final version of the manuscript before submission
   - general advice on how to improve the discussion section but did not read the final version of the manuscript before submission

Three [experience] authors from the same institution conducted a research study and wrote it up as a paper for publication. With agreement from the co-authors and after preparing the manuscript for submission, the corresponding author invited a fourth researcher to be the last-listed author. This author, a [seniority of fourth author], was familiar with the subject matter of the paper but had not been involved with the study. After agreeing to be an author, the fourth researcher gave [contribution].

On the scale of 0 to 10 below please rate how unethical you think the **corresponding author's** behaviour is:



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Scenario 5

Variables for randomisation:
1. Experience:
   - senior experienced
   - junior inexperienced
2. Length of conflict:
   - One year
   - Three years
3. Financial arrangement with company:
   - received a research grant from Company X in relation to a product discussed in the review article
   - received speaking fees from Company X for a lecture at a conference that included a discussion of a product included in the review article

A [experience] researcher submitted an unsolicited narrative review article to a medical journal. The article reviewed the treatment benefits of several major pharmaceutical products commonly used in the field. [Length of conflict] prior to this, the researcher [financial arrangement with company], but did not mention this on submission of the review.

On the scale of 0 to 10 below please rate how unethical you think this researcher's behaviour is:

SECTION 2

This section asks about your knowledge of specific publication issues. Please select the statement that best describes your knowledge of each of the seven topics.

1) **Self-plagiarism** is defined as the reuse or recycling of one's own previously published text, theories, images, data or tables usually without citation.

Please indicate your level of knowledge of self-plagiarism
- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

2) **Image manipulation** involves the modification of the originally captured image including the insertion or deletion of visual data.

Please indicate your level of knowledge of image manipulation:
- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

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3) **Plagiarism** constitutes the use of the words, theories, images or data of others without proper credit and involves the passing off of material as one's own.

Please indicate your level of knowledge of plagiarism:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

4) **Prior publication** involves the use of data, tables and images that have previously been made public, often in a setting other than a journal article.

Please indicate your level of knowledge of prior publication:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

5) **Authorship** is defined as the identification of an individual who has contributed significantly to the reported research and the composition of the paper. Many journals have adopted criteria that define what contributions constitute authorship.

Please indicate your level of knowledge about authorship:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

6) **Conflict of interest** has been defined as a set of conditions in which professional judgment concerning a primary interest, such as patient welfare or the validity of research, can be influenced by a secondary interest, such as personal or financial gain.

Please indicate your level of knowledge about conflict of interest:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

7) **Dual submission** is defined as the simultaneous submission of the same manuscript to more than one journal.

Please indicate your level of knowledge of dual submission:

- I have no knowledge of this topic
- I have some knowledge of this topic
- I have substantial knowledge of this topic

SECTION 3

1) In which country do you mainly work?

2) In which country did you mainly train as a researcher?

3) Are you?

- Female
- Male

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4) What is your age? _____

5) What is your first (main) language?

- English
- Other (please specify): _____

6a) What is your clinical specialty?

OR

6b) Or if you are primarily an academic researcher, what is your research speciality? _____

7) For how many years have you been an active researcher?

- 1 – 2 years
- 3 – 5 years
- 6 – 10 years
- 11 – 15 years
- 16 – 20 years
- 21 – 25 years
- 26 - 30 years
- More than 30 years

8) Approximately how many research or review papers have you had published in journals (including papers that you have co-authored)? _____

9) On average, approximately how many journal articles do you peer review in a year? _____

10) Have you ever performed an editorial role, such as Editor in Chief or acted as an Editorial Board member?

- Yes
- No

11) How would you rate the quality of the training/guidance you have received on the ethics of publishing scientific research?

	Excellent	**Good**	**Average**	**Poor**	**I have never received this type of training/guidance**
From a scientific mentor					
A course you attended devoting some time to this topic					
A course you attended specifically on this topic					
Online resources on this topic					

Thank you for your help

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Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

Item Category	*Checklist Item*	*Explanation*	*Page No.*
Design	Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	5
IRB (Institutional Review Board) approval and informed consent process	IRB approval	Mention whether the study has been approved by an IRB.	15
	Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	5
	Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	5
Development and pre-testing	Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	5
Recruitment process and description of the sample having access to the questionnaire	Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	5
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	5
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	NA
Survey administration	Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey,	6

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Item Category	Checklist Item	Explanation	Page No.
		were the responses entered manually into a database, or was there an automatic method for capturing responses?	
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	NA
	Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	5
	Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	5
	Time/Date	In what timeframe were the data collected?	5
	Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	5 & 6
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions.	NA
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	Appendix 1
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	5
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if “yes”, how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as “not applicable” or “rather not say”, and selection of one response option should be enforced.	No
	Review step	State whether respondents were able to	5

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Item Category	*Checklist Item*	*Explanation*	*Page No.*
		review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	
Response rates	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	NA
	View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.	NA
	Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called “recruitment” rate.	8
	Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate “informed consent” page or if the survey goes over several pages. This is a measure for attrition. Note that “completion” can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word “completeness rate”.)	8
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	6
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours).	5

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Item Category	*Checklist Item*	*Explanation*	*Page No.*
		Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	
	Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	NA
	Registration	In “closed” (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	5
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	8
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined.	NA
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	NA

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