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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 understudied. 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 range (0 to 10 points) 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 seven 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.

Strengths and limitations of this study

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

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 postdoctoral 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. Thirty-eight per cent of those who had been authors on previous publications reported that a coauthor 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 geographical 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.

METHODS

Sample

Between 1 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 2 weeks and 2 months after the initial mailing. We did not survey non-respondents to learn their reasons for non-response.

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 (online supplementary 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; (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). Each vignette was presented on a single page followed by section 2 then 3 on separate pages. Respondents were not allowed to go back and change 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. Table 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

Table 1 List of variables and statements 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
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 coauthors 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 coauthored 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	▶ 1 year ▶ 3 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

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

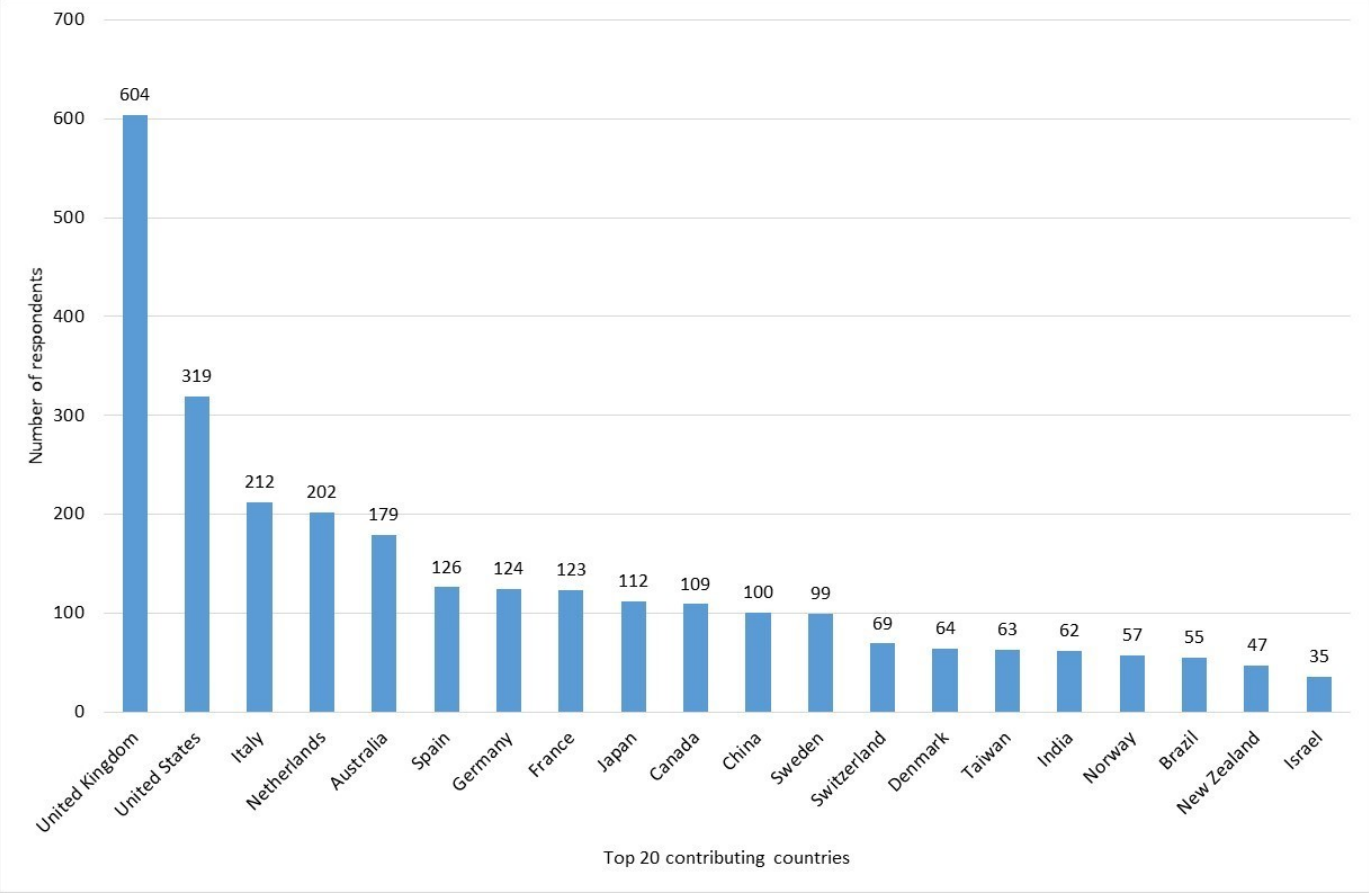

Figure 1 Responses by country of work for the top 20 contributing countries.

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

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 prespecified. 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 χ^2 tests. The primary analysis was conducted for each vignette using several generalised linear models with

Table 2 Respondent characteristics for those completing at least some of the questionnaire (n=4043)

Characteristic	All respondents (n=4043)
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) no of peer reviews conducted annually (n)	5 (2, 10) (n=3258)
Median (25th, 75th) no of papers published (n)	30 (10, 70) (n=3271)

Not all percentages sum to 100% due to rounding. Figures are numbers (%) unless indicated otherwise.
*Due to a computer coding mistake, this value was stored with missing values and was imputed using deterministic methods (ie, the value was deduced by examining the other responses).

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 table 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 value <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.

RESULTS

Respondent characteristics

After correcting for delivery failures, 10 582 people were sent an invitation. Also, 4043/10 582 (38%) completed at least some of the survey. Of those responding, 3090 (76%) completed the entire survey and 3668 (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] (5, 12) min.

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 women and 50% men (table 2). Roughly 17% of the 3222 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. A total of 1073 (26.5%) 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 3). 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

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	–

All correlations p<0.0001.
*Reported as a proportion of the number who completed each item.

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 (α=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.

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 4). 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 (ie, 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

Table 4 Receipt of and perceived quality of ethical training (n=4043)

Type of training/guidance	Not received	Perceived quality of training 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)

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).

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 a 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.

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 (eg, 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). 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

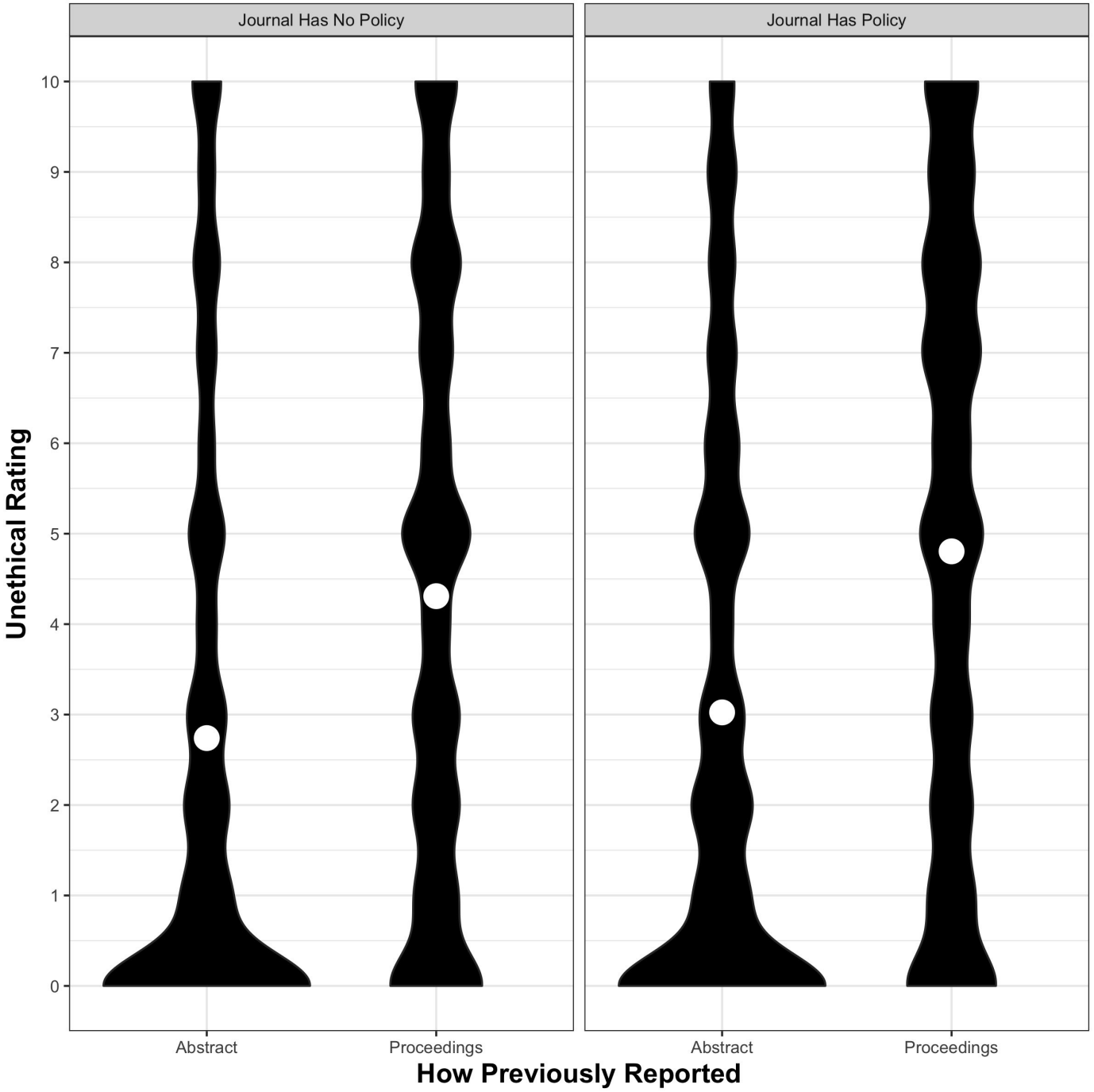

Figure 2 Prior publication vignette response.

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.

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 USA.[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

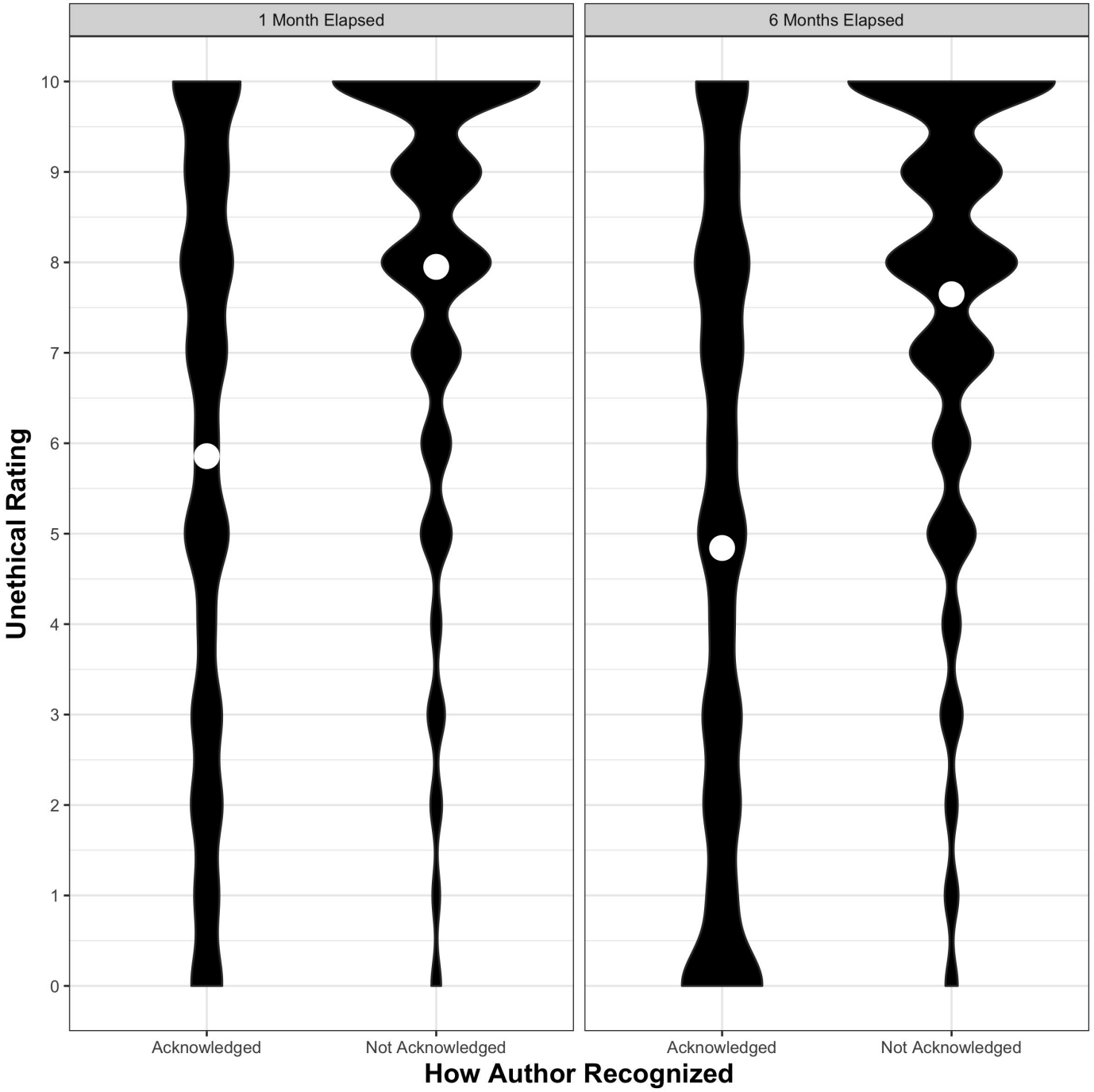

Figure 3 Author omission vignette response.

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 judgements 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

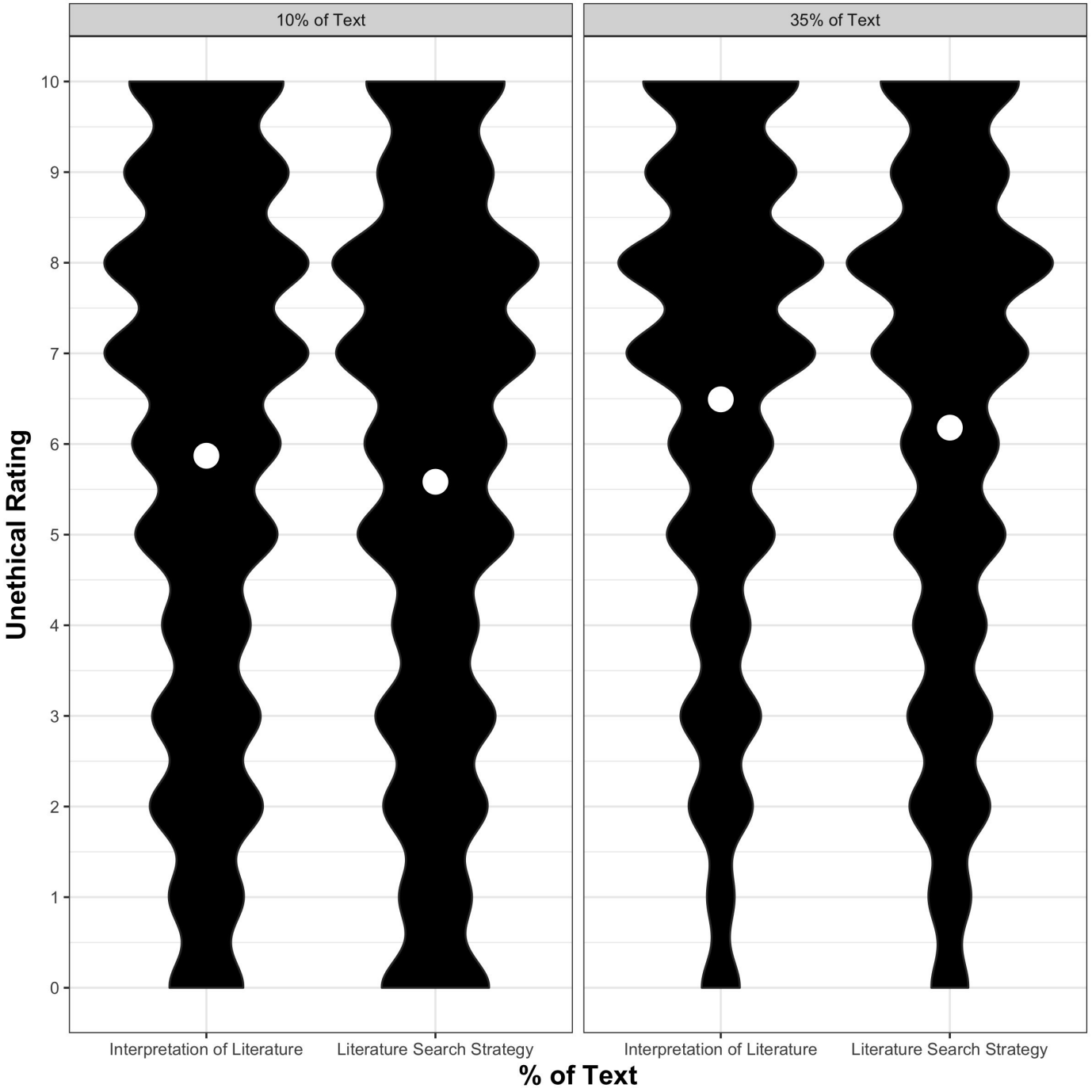

Figure 4 Self-plagiarism vignette response.

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 would be representative of researchers in general, not just

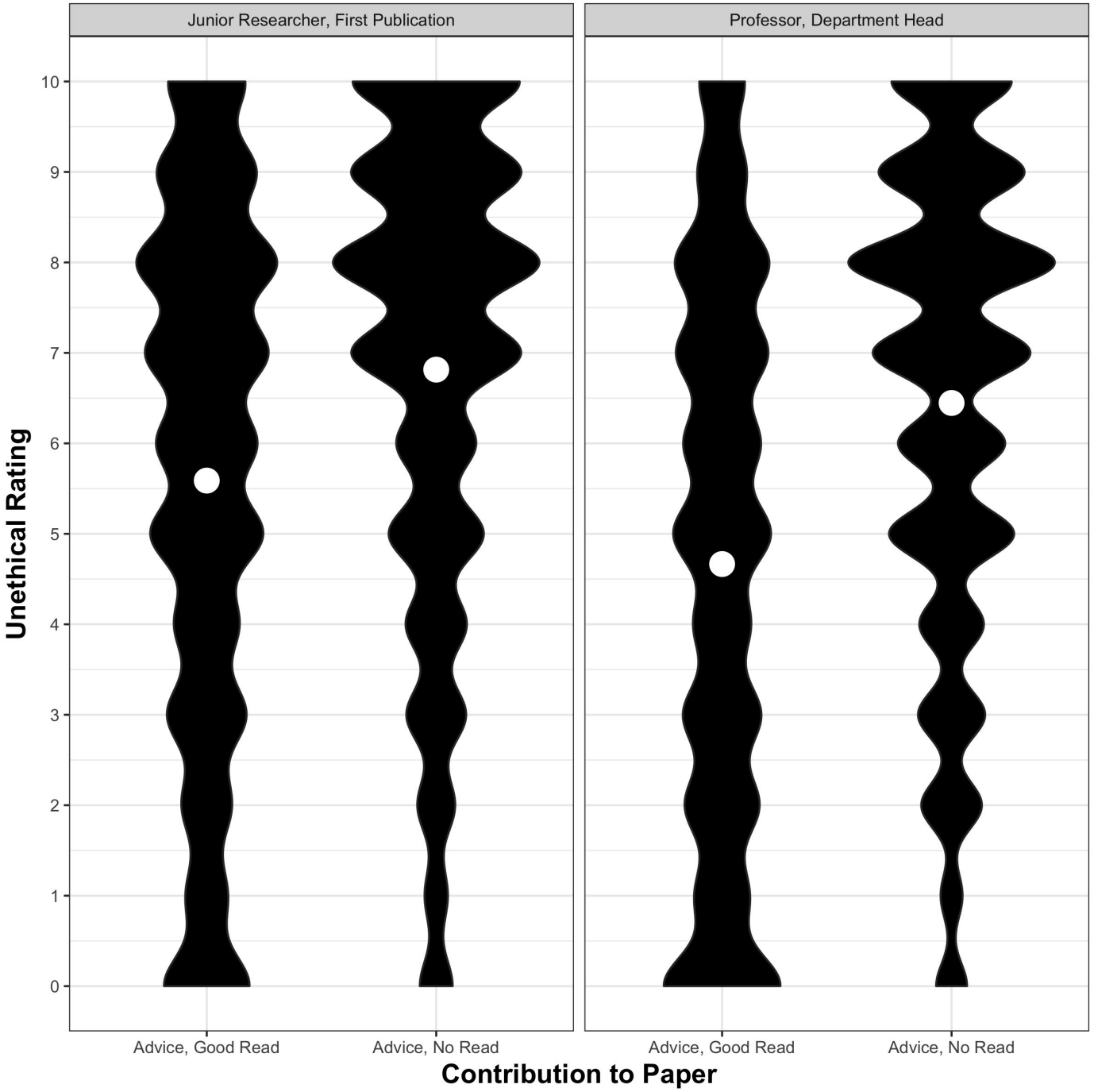

Figure 5 Honorary authorship vignette response.

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

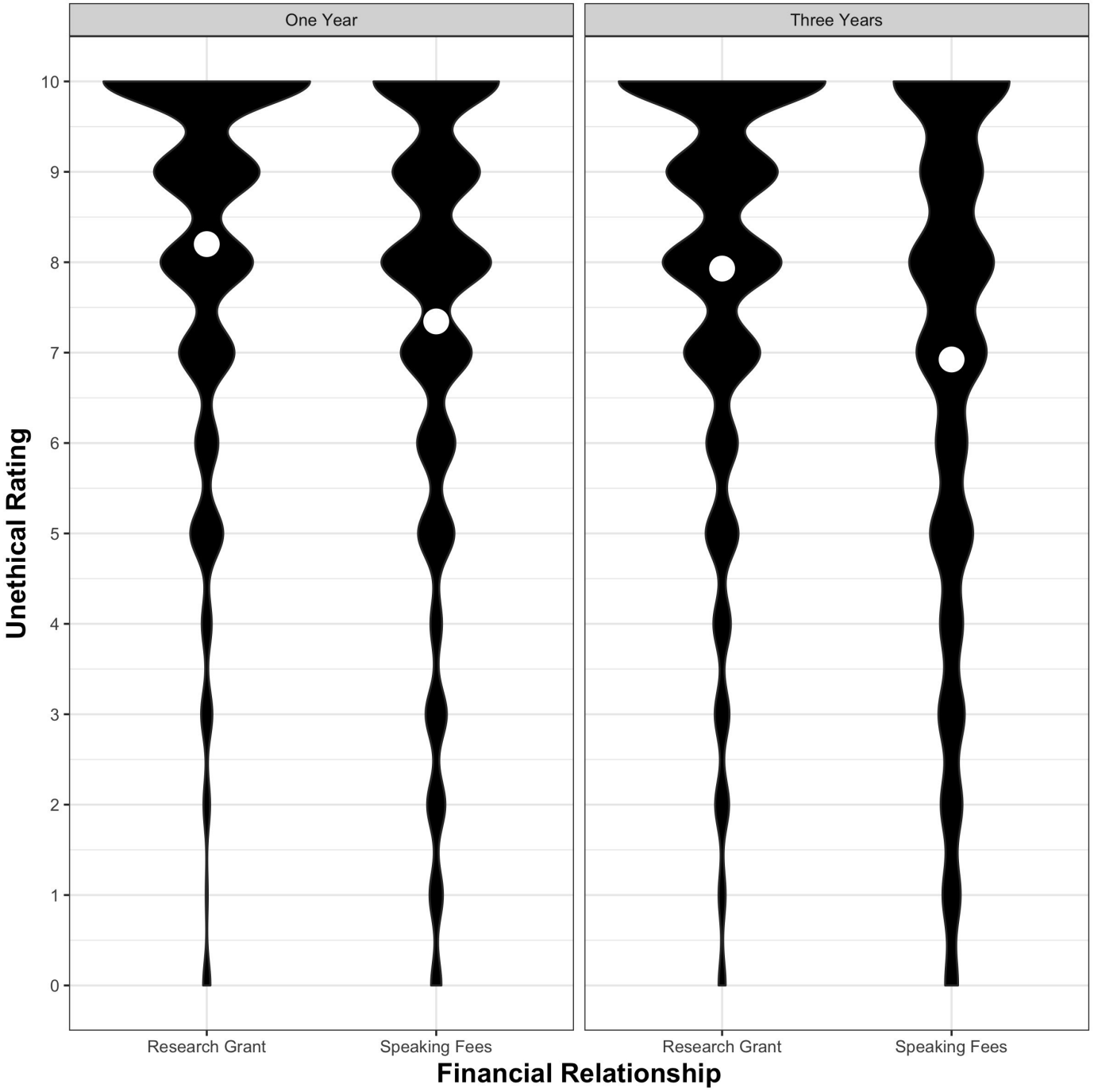

Figure 6 Conflicts of interest vignette response.

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 (eg, 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]

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 COPE from a handful of editors 15 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 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]Among 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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Contributors All authors (SS, JR, EL, DBP, SM, TTH) 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, TTH 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. TTH conducted all statistical analysis and was blinded to the respondents' identities and signed a confidentiality statement for the BMJ. All authors (SS, JR, EL, DBP, SM, TTH) helped interpret the findings and approved the final version of the manuscript for publication.

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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. TTH, JR and DBP have no relevant conflicts of interest.

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