Associations between attitudes towards scientific misconduct and self-reported behavior

Søren Holm[1,2] and Bjørn Hofmann[2,3]

[1]Centre for Social Ethics and Policy, School of Law, University of Manchester, Manchester, UK;

[2]Centre of Medical Ethics, University of Oslo, Oslo, Norway;

[3]Institute for the Health Sciences, Norwegian University of Science and Technology, Gjøvik, Norway

Corresponding Author: Søren Holm

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Abstract

We investigate the relationship between doctoral students' attitudes towards scientific misconduct and their self-reported behavior. 203 questionnaires were distributed to doctoral candidates at the Faculty of Medicine, University of Oslo 2016/2017. The response rate was 74%. The results show a correlation between attitudes towards misconduct and self-reported problematic behaviors among doctoral students in biomedicine. The four most common reported misbehaviors are adding author(s) who did not qualify for authorship (17.9%), collecting more data after seeing that the results were almost statistically significant (11.8%), turning a blind eye to colleagues' use of flawed data or questionable interpretation of data (11.2%), and reporting an unexpected finding as having been hypothesized from the start (10.5%). We find correlations between scientific misbehavior and the location of undergraduate studies and whether the respondents have had science ethics lectures previously. The study provides evidence for the concurrent validity of the two instruments used to measure attitudes and behavior, i.e. the Kalichman scale and the Research Misbehavior Severity Score (RMSS). Although the direction of causality between attitudes and misbehavior cannot be determined in this study the correlation between the two indicates that it can be important to engender the right attitudes in early career researchers.

Background

Our knowledge about scientific misconduct is increasing. We know that there are non-negligible rates of serious misconduct, e.g. fabrication, falsification and plagiarism in many areas of academic research; and that other types of misconduct, e.g. authorship misconduct and problematic data manipulation are even more prevalent ((de Vries, Anderson, and Martinson 2006, Martinson et al. 2006, Anderson, Martinson, and De Vries 2007, Redman, Yarandi, and Merz 2008, Marusic, Bosnjak, and Jeroncic 2011, Hofmann et al. 2015a, Bozeman and Youtie 2016, Saurin 2016, Fanelli 2009, John, Loewenstein, and Prelec 2012, Pupovac and Fanelli 2015, Pryor, Habermann, and Broome 2007, George 2016, Bakker and Wicherts 2011, Tijdink, Verbeke, and Smulders 2014, Tijdink et al. 2016, Ana et al. 2013, Ranstam et al. 2000, Davis, Riske-Morris, and Diaz 2007, Lafollette 2000, Sarwar and Nicolaou 2012, Fang, Bennett, and Casadevall 2013, Stern et al. 2014, Okonta and Rossouw 2014, Komic, Marusic, and Marusic 2015). We also have some knowledge about the factors that are correlated with or causally linked to scientific misconduct, such as publication or funding pressures, general scientific culture and personality types (Tijdink et al. 2016, Martinson et al. 2009, DuBois et al. 2013, Fanelli 2010). In this study our aim to add to this growing literature by exploring two issues.. First we investigate the relationship between doctoral students' attitudes towards scientific misconduct and their self-reported problematic behavior. Our hypothesis is that the more their attitudes are in accordance with generally accepted norms in research integrity, the fewer instances of misbehavior or misconduct will they report.

Then we address the issue of which background factors that are important for the severity of reported research misbehavior. We hypothesise that none of the following factors are associated with increased reporting of misconduct: gender, type of research, where the candidate did his undergraduate studies, or whether the candidate previously had attended lectures or courses in science ethics.

In addition to providing new knowledge on the link between attitudes and misconduct, this study offers input as to where to direct our attention and resources in order to improve research integrity. Progress and success in science depends on trust. To maintain and increase this trust is of the utmost importance for researchers, the scientific community, and for society in large.

Materials and methods

A two-page questionnaire with questions on knowledge of, attitudes to, and behavior with respect to various forms of scientific misconduct was used. The questions on knowledge and actions stem from a survey developed at the Department of Medical Ethics in Lund, Sweden (Nilstun, Lofmark, and Lundqvist 2010), while the questions on attitudes stem from a recently validated survey originally developed by Kalichman (Kalichman and Friedman 1992, Holm and Hofmann 2017). A questionnaire with these elements has been used previously in studies in Norway, Sweden and Denmark (Hofmann, Myhr, and Holm 2013, Hofmann and Holm 2016, Hofmann et al. 2015b, Jensen et al. 2018). The Research Misbehavior Severity Score (RMSS) from a Dutch study (Tijdink et al. 2016) was added to 1) enable a comparison between two different methods for quantifying self-reported problematic behaviours, and 2) to derive data for a possible concurrent validation of the Kalichman and RMSS scales .

The Kalichman questionnaire contains 14 statements concerning attitudes towards misconduct, such as “It is never appropriate to report experimental data that have been created without actually having conducted the experiment” (S1 contains all the statements). The statements are scored on a 5 point Likert scale from “completely disagree” to “completely agree”. We have previously shown the psychometric validity of a 13 question scale, and 4 sub-scales derived from this questionnaire (Holm and Hofmann 2017). Scores for the total scale and sub-scales are formed by simple addition, with two items being reverse scored.

The RMSS contains 22 questions concerning self-reported scientific misbehaviour, such as “Fabricated data?”. The questions are scored on a 5 point scale from “0 times” to “Always” (S2 contains all the statements). The RMSS score is constructed by translating the scores of the items dichotomously (behavior yes/no) and assigning the items different weights according to the severity of the behavior, as described in (Tijdink et al. 2016):

> “The most severe type of misbehavior (based on the definition of fraud, i.e. fabrication, falsification and plagiarism) was 3 points. The other item scores were based on consensus in the research group and were assigned 1 (for moderate) and 2 (for severe) misbehavior. Positive answers (committing the behavior at least ‘once’ in the past 3 years) to the most severe misbehavior questions (items 1, 2, 8, 9, 12, 15 and 19) were assigned three points, positive answers of the severe research misbehavior questions were assigned two points (items 4, 7, 10, 14, 16, 18 and 20) and positive answers to the moderate research misbehavior questions were assigned one point (items 3, 5, 6, 11, 13, 17, 21 and 22). Scores were added up to calculate the composite research misbehavior severity score (RMSS) (maximum range: 0–43).” (Tijdink et al. 2016)

Terms such as ‘scientific dishonesty’, ‘plagiarism’, ‘fabrication of data’, and ‘falsification’ were given standard definitions at the beginning of the questionnaire.

The participants in the study were post-graduate students enrolled in the PhD program at the Faculty of Medicine, University of Oslo in Norway. The questionnaire was printed on yellow paper and distributed to doctoral students attending basic, compulsory courses in research methodology, philosophy of science, and research ethics in the academic year 2016/2017. The questionnaires were anonymous and participation was voluntary, which was emphasised both in the introduction letter and when handing out the questionnaires. Students could complete the questionnaire at a time and place of their own choosing and return was in an unmonitored box thereby ensuring complete anonymity.

The data was analysed using standard statistics functions in SPSS 24. Because both the Kalichman scale and the RMSS data is non-normally distributed the analyses used non-parametric methods.

No personal data traceable to individual participants was registered, and the study was thus not subject to REC/IRB approval, in accordance with Norwegian law. Participants consented to participating in the study by filling in and handing in the form.

Results

203 questionnaires were distributed, of which 166 were returned and 150 were valid. The overall response rate was 73.89% (81.77%). Table 1 gives an overview of the demographical data for the respondents.

Table 1 Demographical data for the respondents of the survey

N = 150	**Category**	**No.**
Gender	Male	51
	Female	79
Kind of research	Clinical Research	76
	Basic Research	35
	Other Research	16
Duration of doctoral study	Less than or equal to 1 year	98
	1-2 years	27
	More than 2 years	4
Lectures or courses in science ethics as an undergraduate	Yes	89
	No	16
	Can't remember	24
Location of undergraduate studies	Norway	91
	Sweden	34
	Other	6

We analysed the relation between demography and RMSS scores using Kruskal-Wallis and Mann-Whitney tests. The analyses show that persons who had their undergraduate studies in Sweden had a higher RMSS score than those who had studied in Norway or elsewhere. See table 2. We further found that those not having ethics lectures or courses during their undergraduate studies and those who did basic research had higher RMSS scores. There was also a trend towards respondents having higher RMSS scores if they had pursued their doctoral studies for longer. There was no difference for gender.

Table 2 RMSS score for background variables

RMSS score	Mean	Median	SD	N
Location of UG studies				
Norway	1.62	0.0	3.53	91
Sweden	4.18**	2.0	4.88	34
Other	1.83	2.0	1.60	6
Science ethics lectures or courses during UG study				
Yes	1.84	0.0	3.34	89
No	4.83**	3.0	5.46	24
Can't remember	1.25	0.0	3.80	16
Kind of research conducted				
Clinical	1.59	0.0	3.28	76
Basic	4.26*	2.0	5.25	35
Other	1.75	0.5	3.09	16
Duration of doctoral research+				
Less than 1 year	2.15	0.0	3.99	98
1-2 years	3.07	1.0	4.39	27

More than 2 years	1.50	1.50	1.29	4

* p =< 0.05 ** p =< 0.005Kruskall-Wallis test followed by Mann-Whitney test for pair-wise differences
+ p=< 0.05 Jonckheere–Terpstra test for trend

Comparing the self-reports of misconduct elicited by the questions derived from Nilstun et al and the RMSS shows that the RMSS elicits a higher rate of self-reporting for equivalent behaviors if compared to both definite 'Yes' answers in the Nilstun questionnaire and the combination of 'Yes' and 'Uncertain' answers (see Table 3).

Table 3 Comparison of self-reports of misconduct

Type of Misconduct	**Nilstun 'Yes'**	**Nilstun 'Yes' + 'Uncertain'**	**RMSS**
Fabricated data	1	1	2+
Falsified data	1	1	3++
Plagiarised publication	0	2	11+++ *

+ RMSS Question 1 ++ RMSS Question 2 +++ RMSS question 6 * p=<0.05

The results show a correlation between attitudes as measured by the Kalichman scale and behavior as measured by RMSS. The more the respondent's attitudes were in accordance with ordinary norms of scientific integrity, the lower were the Research Misbehavior Severity Scores (RMSS). The same goes for their attitudes to whistleblowing. There does not appear to be any correlation with respect to the respondents' attitudes to punishment for scientific misconduct. See Table 4 The Kalichman scale had a mean of 53.24 (SD 6.36) and the RMSS had a mean of 2.29 (SD 4.00). Of the respondents who completed the RMSS 56 out of 131 (42.7%) reported at least one misbehavior.

Table 4 Correlation between Kalichman Attitude Towards Misconduct Scale and Research Misbehavior Severity Score (RMSS)

	Correlation coefficient – Spearman rho	**SE**	**p value**
Kalichman 13 item scale	-.256	.089	.004
General attitude sub-scale	-.247	.089	.005
Personal sub-scale	-.154	.086	.083
Whistleblowing sub-scale	-.324	.076	<0.0005
Punishment sub-scale	.079	.087	.371

Details for the Kalichman results, RMSS results and for the questions on actions and knowledge are given in supplementary tables S1-S3 in the Appendix.

Two of the more commonly admitted misbehaviors in the RMSS have related items or scales elsewhere in the questionnaire and we therefore decided to explore any potential statistical correlations. The analysis show that the RMSS item "Turned a blind eye to colleagues' use of flawed

data or questionable interpretation of data?" and the Kalichman Whistleblowing sub-scale are negatively correlated (Spearman rho -.198, SE .071, p = 0.018, dns) And the RMSS item "Added one or more authors to a report who did not qualify for authorship (honorary author)?" is positively correlated to the item "Have you during the last 12 months been exposed to unethical pressure concerning inclusion or ordering of authors?" (Spearman rho .280, SE .103, p = 0.001, dns).

Discussion

The survey had a high response rate, but there are also some weaknesses in the study. Asking people to self-report behavior that they know is perceived as problematic and socially unacceptable is likely to lead to under-reporting, even if all possible steps have been taken to ensure anonymity. The reported incidence of misbehaviour must thus be taken as the lower bound of the actual incidence.

The respondents were all doctoral students, and therefore early in their scientific careers and most respondents were furthermore relatively early in their doctoral studies. They thus had limited exposure to the research environment and limited time to commit any research misbehaviors. This is to some extents substantiated by the trend in RMSS scores according to length of doctoral study. This must be taken into account when interpreting the results. Another weakness is that all of the respondents were pursuing their studies at the same institution which may limit the generalisability of the results.

The four most common reported research misbehaviors are:

- Added one or more authors to a report who did not qualify for authorship (honorary author) (17.9%)
- Decided to collect more data after seeing that the results were almost statistically significant (11.8%)
- Turned a blind eye to colleagues' use of flawed data or questionable interpretation of data (11.2%)
- Reported an unexpected finding as having been hypothesized from the start (10.5%)

These numbers are lower than those found by Tijdink et al using the RMSS in a sample of Dutch biomedical research scientists (Tijdink et al. 2016), but this may be due to the fact that our respondents have not all had 3 years research experience and the reported research misbehavior incidence may therefore not in reality be a 3 year incidence but reflect a shorter time period.

The RMSS seems to elicit more self-reporting of misconduct than the questions originally used by Nilstun et al where questions are directly comparable (Nilstun, Lofmark, and Lundqvist 2010). There may be several explanations for this. The answer formats are different and it may be less difficult for respondents to admit to misconduct by ticking the lower of four increasing frequencies of misconduct, than by ticking a fairly stark 'Yes'. The time period respondents are asked to consider is also different, 12 months for the Nilstun questions, 3 years for the RMSS.

We find that there is correlation between doctoral candidates' attitudes and their self-reported behavior. This result is expected and is evidence of the concurrent validity of both instruments, i.e. the Kalichman scale for measuring attitudes and the RMSS for measuring behavior. Given that the

data are generated by a cross-sectional survey it is not possible to indicate if the correlation indicates causality or what direction any causal link might have. It may be that attitudes influence behavior, or that behavior changes attitudes.

The fact that we do not find any gender differences with respect to RMSS is in accordance with other research (Fanelli, Costas, and Larivière 2015). We do, however find some relations between reported misbehaviors and other background factors. The results show that place of undergraduate studies was correlated with RMSS results. Having studied in Sweden was associated with significantly higher reported research misconduct. To some extent this is compatible with a previous study studying doctoral students in Norway and Sweden (Hofmann et al. 2015a). There may be many reasons for this. The recruitment of PhD candidates from Sweden to Norway may be biased in some way or there may be differences in academic cultures in Sweden and Norway, although the overall structure and contents of undergraduate studies in the biomedical sciences are very similar in the two countries. Moreover, the teaching on ethics and research integrity may be different in the two countries. However, it is somewhat puzzling that the RMSS score for the doctoral candidates that did their undergraduate studies in other countries (than Norway and Sweden) is comparable to those in Norway, although the number of 'foreign' students is small. It is generally acknowledge that regional and cultural differences are important in relation to attitudes towards and incidence of scientific misconduct (Ana et al. 2013).

Our finding that previous ethics education is associated with lower RMSS is of course encouraging. The effect seen is relatively large, but other studies have shown moderate results from ethics teaching on research integrity (Anderson et al. 2012, Kaiser 2014). There is no obvious explanation for the difference between our study and the other studies.

Our finding that doctoral candidates doing basic research report higher RMSS is also difficult to interpret.

In the questionnaire the questions about background factors come before the questions about behaviors and attitudes. It could therefore be the case that the respondents have generated a particular view of the 'demand characteristics' of the task from the demographic questions, and that the differences found in relation to previous ethics education are fully explainable as a response to perceived demand characteristics (McCambridge, De Bruin, and Witton 2012). That is, respondents who have previous ethics education 'know' that the researchers want to see a positive effect of this and answer accordingly. An appeal to demand characteristics is, however unable to explain differences found in relation to place of undergraduate study and type of research being conducted.

We also find that candidates that are prone to "turn a blind eye" have less positive attitudes towards whistleblowing. Moreover, we find that persons who experience pressure with respect to authorship are more likely to have added honorary authors. Here we must again emphasise that correlation is not proof of causality, or the direction of causality.

There is an international debate on which terms to use for scientific misconduct (misbehavior, questionable research practice, fraud etc). This debate is important but we have not engaged with it in this project, but used the terms most convenient to the context.

Conclusion

This study shows that there is a correlation between attitudes towards scientific misconduct and self-reported problematic scientific behaviors among doctoral students in biomedicine. Although the direction of causality cannot be determined in this study the correlation may indicate the importance of engendering the right values and attitudes in early career researchers. This is further emphasised by our findings that there are correlations between scientific misbehavior and the location of undergraduate studies and whether or not the respondents have had science ethics lectures or courses in their undergraduate studies.

The study also provides evidence for the concurrent validity of the Kalichman scale for measuring attitudes and the RMSS for measuring behavior.

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Appendix

S1 Explanations of and details for the Kalichman 13 items scale, General attitude sub-scale, Personal sub-scale, Whistleblowing sub-scale, and Punishment sub-scale

Statement (Scored on 5 point Likert scale 1-5 from "Completely disagree" to "Completely agree") ***In forming the scale item 7 and 8 are reverse scored***	**Mean**	**SD**	
Q1. It is never appropriate to report experimental data that have been created without actually having conducted the experiment.	4.55	1.02	General attitude towards misconduct scale Score = 26.5 SD = 3.58
Q2. It is never appropriate to alter experimental data to make an experiment look better than it actually was.	4.77	.571	
Q 3. It is never appropriate to try a variety of different methods of analysis until one is found that yields a result that is statistically significant.	3.71	1.02	
Q4. It is never appropriate to take credit for the words or writing of someone else.	4.59	.771	
Q5. It is never appropriate to take credit for the data generated by someone else.	4.42	.919	
Q6. It is never appropriate to take credit for the ideas generated by someone else.	4.40	.907	
Q7. If you are confident of your findings, it is acceptable to selectively omit contradictory results to expedite publication.	1.97	1.20	Attitude to personal misconduct scale (*reverse scored)* Score = 3.59 SD = 2.33
Q8. If you are confident of your findings, it is acceptable to falsify or fabricate data to expedite publication.	1.62	1.28	
Q9. It is more important that data reporting be completely truthful in a publication than in a grant application.	2.87	1.32	Excluded
Q10. If you witness someone committing research misconduct, you have an ethical obligation to act.	4.17	.812	Whistleblowing scale Score = 11.9 SD = 2.21
Q11. If you had witnessed a co-worker or peer committing research misconduct, you would be willing to report that misconduct to a responsible official.	3.91	.817	
Q12. If you had witnessed a supervisor or principal investigator committing research misconduct, you would be willing to report that misconduct to a responsible official.	3.84	.839	
Q13. If fabricated data are discovered in a published paper, all co-authors must equally share in the blame.	3.56	1.04	Punishment scale Mean = 6.40 SD = 1.91
Q14. If fabricated data are discovered in a published paper, all co-authors must get the same punishment.	2.84	1.07	

Table S2 Results for the Research Misbehavior Severity Score for each behavior

Behavior	**0 times**	**Once**	**Multiple times**	**Regularly**	**Always**
1. Fabricated data?	146	2			
2. To confirm a hypothesis, selectively deleted or changing data after performing data analysis?	143	2	1		
3. Deleted data before performing data analysis?	142	3	1	2	
4. Concealed results that contradicted previous research you published?	146	1			
5. Used phrases or ideas of others without their permission?	136	6	5		

6. Used/ing phrases or ideas of others without citation?	136	5	6		
7. Turned a blind eye to colleagues' use of flawed data or questionable interpretation of data?	127	14	2		
8. Modified the results or conclusions of a study under pressure from an organization that (co-) funded the research?	137	5	2		
9. Not published (part of) the results of a study?	130	7	5	1	
10. Deliberately not mentioned an organization that funded your research in the publication of your study?	141	3			
11. Added one or more authors to a report who did not qualify for authorship (honorary author)?	119	20	6		
12. Selectively modified data after performing data analysis to confirm a hypothesis?	136	6	1		
13. Reported/ing a downwardly rounded p value (e.g. reporting that a p value of .054 is less than .05)?	140	3	1		
14. Reported an unexpected finding as having been hypothesized from the start?	128	12	2	1	
15. Decided whether to exclude data after looking at the impact of doing so on the results?	134	7	4		
16. Decided to collect more data after seeing that the results were almost statistically significant?	127	9	4	3	1
17. Omitted a contributor who deserved authorship from the author's list?	141	2	1		
18. Stopped collecting data earlier than planned because the result at hand already reached statistical significance without formal stopping rules?	140	1	3		
19. Deliberately failed to mention important aspects of the study in the paper?	141	1	2		
20. Not disclosed a relevant financial or intellectual conflict of interest?	141	2	1		
21. Spread results over more papers than needed to publish more papers ('salami slicing')?	139	4	2		
22. Used confidential reviewer information for own research or publications?	144	1			

Table S3 Results for actions and knowledge

Have you yourself during the last 12 months been the object of pressure to	**Yes**	**No**	**Uncertain**
• Fabricate data	0	149	0
• Falsify data	2	147	0
• Plagiarise data	1	148	0
• Plagiarise publications (in whole or in part)	1	148	0
• Present results in some other misleading way	2	125	9
Have you yourself during the last 12 months ever			
• Fabricated data	1	148	0
• Falsified data	1	148	0
• Plagiarised data	0	149	0
• Plagiarised publications (in whole or in part)	0	147	2
• Presented results in some other misleading way	1	135	4
Do you know about anyone in your department who during the last 12 months has			
• Fabricated data	1	146	2
• Falsified data	2	142	3
• Plagiarised (in any way)	2	146	1
• Presented results in some other misleading way	3	138	6
Have you during the last 12 months been exposed to unethical pressure concerning			
• Inclusion or ordering of authors	15	126	7
• Design/method	0	144	5
• Analysis	2	143	4
• Results	3	142	4