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Rethinking the Value of Author Contribution Statements in Light of How Research Teams Respond to Retractions

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Abstract

The authorship policies of scientific journals often assume that in order to be able to properly place credit and responsibility for the content of a collaborative paper we should be able to distinguish the contributions of the various individuals involved. Hence, many journals have introduced a requirement for author contribution statements aimed at making it easier to place credit and responsibility on individual scientists. We argue that from a purely descriptive point of view the practices of collaborating scientists are at odds with the requirement for author contribution statements. We also argue that from a normative point of view the authorship policies may be unnecessary. Our arguments draw on an examination of 35 years of retraction notices in the journal *Science*.

Keywords: Collaborative research; retractions; authorship policies; scientific journals; author contribution statements

1. Introduction

Journal editors and editorial boards often assume that in order to be able to properly place credit and responsibility for the content of a scientific paper we should be able to distinguish the contributions of the various *individuals* involved. Journal editors have thus developed authorship policies aimed at making it easier to place credit and responsibility on individual scientists by tracking their contributions. In particular, it is common that journals in the sciences require authors of collaborative papers to provide author contribution statements.

We analyse the value of this practice. We argue that from a purely descriptive point of view authorship policies aimed at distributing the responsibility for the content of a scientific paper among the individual contributors are at odds with the actual practices of scientists who work collaboratively. We also argue that from a normative point of view the authorship policies may be unnecessary. We build our arguments on data drawn from an examination of how collaborating scientists respond when they need to retract a paper they have published. Specifically, we examine 35 years of retraction notices in the journal *Science*, all of which involve the retraction of a previously published collaborative paper. The teams that produced the retracted papers range in size from two scientists to 26 scientists.

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What we find is that the retraction tends to be made by the research team rather than by individual team members or the editor of the journal. And more importantly, when the research team makes the retraction, the team as a whole often takes responsibility for what went wrong, rather than identify individual team members as responsible for what went wrong.

The retraction practices that we observe do not fit well with the common requirement for author contribution statements insofar as the contribution statements are aimed at distributing the responsibility for the content of a scientific paper among the individual contributors. Hence, from a purely descriptive point of view the practices of collaborating scientists are at odds with authorship policies widely used by journals in the sciences.

We also draw a normative conclusion from the data. We argue that the observed behavior of research teams when they retract a paper is generally commendable and support the conclusion that the requirement for author contribution statements may be unnecessary. Given our data, it is not clear that there is any significant value in requiring contribution statements. The research teams take care of the sorts of concerns that contribution statements seem designed to address. Note that we focus on the value of author contribution statements in placing responsibility when retractions are issued. Our argument leaves open the possibility that author contribution statements play a valuable role in placing credit or responsibility in other contexts.

2. Authorship policies

Since 1988, the International Committee of Medical Journal Editors (ICMJE) has issued recommendations for how journals should define the role of authors (Huth and Case 2004: 18). These recommendations have been revised and updated periodically. The most recent version of the recommendations was issued in 2019. Many hundreds of journals, both medical journals and non-medical journals, have authorship policies that are informed by the ICMJE recommendations (for a list of the journals that state that they follow the ICMJE recommendations, see ICMJE 2020). Our discussion will focus on the ICMJE recommendations, in particular the recommendation that journals introduce a requirement for author contribution statements.

In general, the ICMJE recommendations address the rights and responsibilities of individual contributors to a collaborative publication. The purpose of the recommendations is thus twofold:

[The] recommendations are intended to ensure that [1] contributors who have made substantive intellectual contributions to a paper are given credit as authors, but also that [2] contributors credited as authors understand their role in taking responsibility and being accountable for what is published. (ICMJE, 2019; numerals added)

The ICMJE recommendations seem designed principally to prevent both (i) ghost authorship, where scientists contributed substantially to a paper but are not credited as authors, and (ii) “honorary” authorship, where scientists made no contribution to a paper but are nonetheless listed as authors (see, for example, Sismondo 2009). These are not the issues that concern us here. Rather, our focus here will be on the ICMJE recommendations regarding the responsibilities of individual co-authors, that is, the role of individual co-authors in taking responsibility for collaborative publications.

According to the ICMJE recommendations, an individual co-author should take responsibility for the parts she has contributed to a collaborative publication but also

“should be able to identify which co-authors are responsible for specific other parts of the work” (ICMJE 2019). The recommendation that co-authors should be able to identify who has done what seems to be designed to ensure that *individual* co-authors can be held responsible if a problem with the accuracy or integrity of the collaborative publication arises. Another way journals could try to ensure that we can identify who has done what is to require and publish information about the contributions of each of the individuals in the list of authors (see, for example, Sauermann and Haeussler 2017). In fact, ICMJE (2019) strongly encourages this practice, stating that: “Editors are strongly encouraged to develop and implement a contributorship policy”.

Hence, the ICMJE recommendations, and particularly the requirement for author contribution statements, seem designed in part to ensure that *individual* co-authors can be held responsible if a problem with the accuracy or integrity of the collaborative publication arises. The requirement for author contribution statements is probably also intended to aid scientists who work at universities in securing credit for their contributions, especially for tenure and promotion considerations. Hence, the requirement for author contribution statements is a tool for distributing both credit and responsibility among individual co-authors.

Note how the ICMJE recommendations imply a conception of collaborative publications, where each individual co-author of a collaborative paper makes identifiable contributions for which she alone is responsible. The collaborative paper is, in turn, the sum of the individual co-authors’ contributions. Hence, a research team submitting a paper for publication to a journal is regarded as an aggregate of individual scientists, each incurring identifiable responsibilities for the part they contribute to the research reported.

The ICMJE recommendations are widely followed by many journals in full or in part. For example, the medical journal *JAMA* follows all the stated ICMJE recommendations in their authorship policies. And *Science* and *The Lancet* follow the recommendation of asking for author contribution statements. *Nature* also asks for author contribution statements, although their policies are not explicitly informed by the ICMJE recommendations.¹

JAMA, *Nature* and *Science* go further than the ICMJE recommendations by requiring that one or more co-authors take responsibility for the integrity of *all* parts of a collaborative paper. Prima facie, there appears to be some tension between this requirement and their requirement for author contribution statements. The requirement for author contribution statements suggests that each member of the team contributed an identifiable part of the joint work and is responsible for that part and only that part. At the same time, the authorship policies of *JAMA*, *Nature* and *Science* require that one or more co-authors take responsibility for the integrity of all contributions to the joint work.

This tension can be resolved if we think of the two requirements as having different aims and involving responsibility for different things. The requirement for author contribution statements involves the responsibility of individual co-authors for their own contributions. This requirement appears to be aimed at making sure that individuals can be held responsible for problems *if* problems arise with published research. The requirement for some co-authors to take responsibility for every part of the

¹*Science* appears to have been asking for contribution statements since 2010 (Alberts 2010). But contribution statements are not a formal requirement that is enforced by the editors of *Science*. Only one of the 15 papers in *Science* that have been published since 2010 and later retracted contains an author contribution statement (the paper in question is Mahato *et al.* 2013). This means that the policy on contribution statements will not have influenced the data we discuss in this paper in any significant way.

collaborative work seems to be designed as a means to *prevent* problems arising in the first place. We interpret this latter requirement to be asking lead researchers to take responsibility for overseeing the research process in such a way that any potential problems with the research are more likely to be uncovered before the research is published.

In the data we collected, there are several examples of data manipulation or fabrication by a junior researcher where the lead researcher has turned out to be far removed from the data collection process, and where the misconduct may have been prevented if the lead researcher had followed the data collection process more closely (see, for example, Oransky 2015; Enserink 2017).² In some cases, this makes the lead researcher responsible when a problem does arise. In other cases, the deception by the individual engaged in misconduct may have been so subtle that it is unreasonable to hold the lead researcher responsible.

In this paper, we are not going to examine the requirement demanding that some individuals take responsibility for all parts of a collaborative paper. This requirement has been criticized by scientists and deserves further critical attention (see Biagioli 1999: 21–2). Our concern is with the requirement for author contribution statements insofar as the contribution statements are aimed at distributing the responsibility for the content of a scientific paper among the individual contributors.

3. Honest Error Notices, Misconduct Notices, and Ambiguous Notices

In this and the following two sections, we argue that the retraction practices that we observe do not fit well with the aim of distributing the responsibility for the content of a scientific paper among the individual contributors. Our argument is based on an examination of the retraction notices published in the journal *Science* over the past 35 years, between 1983 and 2017 (the data set is available as Supplementary Material). *Science* is one of the most prestigious scientific journals in the world and, for this reason, is an interesting case for studying retraction practices. In the retraction practices that we have examined, when the research team makes the retraction, the team as a whole often takes responsibility for what went wrong, rather than identifying individual team members as responsible for what went wrong. Whether examinations of retraction notices published in other journals than *Science* would lead to similar results is a question for future research.

The use of retraction notices as a source of data is not new. In fact, retractions have received a lot of attention in recent years. Some studies on retractions use retraction notices to say something about the causes of retraction and in particular the distribution of the causes of retraction (see, for example, Nath *et al.* 2006; Fang *et al.* 2012; Grieneisen and Zhang 2012). While we are also interested in the causes of retraction, we are primarily interested in how research teams behave when they have authored a paper that needs to be retracted.

We will refer to a retraction notice by the date of its publication. [2016 12 16], for example, refers to the retraction notice published in *Science* on December 16, 2016, [YEAR MONTH DAY]. We used the search engine of *Science* at science.com to find all notices retracting either (i) a part of a paper, or (ii) a paper in full. We searched for occurrences of the words: retraction, retractions, retract, retracts, retracted. In two cases, 'retraction' does not appear in the title ([1985 8 23] and [1995 1 20]). Our data set contains 77 retraction notices in total.³

²Of course, we recognize that senior authors also manipulate and fabricate data.

³One paper was retracted first in part and later in full. The retraction notice [2011 10 14] retracts the paper in part, and the later retraction notice [2011 12 23] retracts the paper in full. We only include the later retraction notice in our data set.

In this section, we introduce a distinction concerning the *causes* of retraction. It is a distinction between three mutually exclusive types of retraction notices. We distinguish between (i) Misconduct Notices and (ii) Honest Error Notices. We also have a (iii) Ambiguous Notices category for the notices that are neither clearly Misconduct Notices nor clearly Honest Error Notices.

In the category of Misconduct Notices, we only include notices where there is a clearly stated admission or judgment of misconduct expressed either in the retraction notice itself or in a separate piece in *Science* discussing the retraction. Note that our category of Misconduct Notices contains cases that scientists themselves have judged to be cases of misconduct, rather than cases that we have judged to be cases of misconduct. Often, *misconduct terms* such as “research misconduct” (see, for example, Roberts *et al.* 2007, [2007 7 27]) or “fabrication of data” (see, for example, Stapel and Lindenberg 2011, [2011 12 2]) are used either in the retraction notice itself or in a separate piece in *Science* discussing the retraction. But such misconduct terms need not be used for a case to be included in the category of Misconduct Notices. If such terms are not used, but there is a clearly stated admission or judgment of an *intentional* error that warrants retraction expressed either (i) in the retraction notice itself or (ii) in a separate piece in *Science* discussing the retraction, we still include the case in the category of Misconduct Notices. In other words, if it is made clear that the error that is serious enough for the paper to be retracted was committed intentionally, we include the retraction notice in the category of Misconduct Notices.

For example, the following statement of the reason for the retraction leads us to include this notice in the category of Misconduct Notices: “The first author (R. B. Tracy) has admitted to data alteration such that the primary conclusions of the paper are in question” (Tracy *et al.* 2000, [2000 8 18]). Similarly, the following statement of the reason for the retraction leads us to include this notice in the category of Misconduct Notices: “Certain data points were removed, while other data points were given increased weight in the statistical analysis” (Böhlenius *et al.* 2007, [2007 4 20]).

In the category of Honest Error Notices, we include the retraction notices that give us *no* reason to suspect that misconduct was involved in the retracted research.⁴ These notices describe what went wrong and in doing so give us no reason to suspect misconduct. It is worth stressing that in cases where a notice gives *no* description of what went wrong, we take there to be some reason to suspect misconduct and include the notice in the Ambiguous Notices category. The Honest Error notices are often rather long, going into detail about what went wrong and how the error affects the conclusions of the retracted paper. In Section 5 below, we quote extensively from an Honest Error notice.

In the Ambiguous Notices category, we include the notices where there is some reason to suspect that misconduct was involved in the retracted research but there is no clear statement of misconduct. The notices in the Ambiguous Notices category give no description of what went wrong or so little detail as to what went wrong that it raises the suspicion that the authors of the notice do not know what went wrong or cannot say for legal reasons. The notices in the Ambiguous Notices category can be included neither in the category of Honest Error Notices nor in the category of Misconduct Notices because in these cases it is unclear whether the error described in the notice was an honest error or due to misconduct. Most of the Ambiguous Notices in our data set give no description at all of what went wrong. The retraction notice [1989 1 6] provides

⁴The category of retractions due to honest errors that are signed by all authors of the retracted paper has recently received attention in the literature (see, for example, Fanelli *et al.* 2018; Hosseini *et al.* 2018). But we wish to distinguish both (i) between different causes of retraction and (ii) between retractions made by different actors. In the next section, we introduce a distinction between retractions made by different actors.

an example. The retracted paper has two authors and only the second author signed the retraction notice. The notice merely states:

I have decided to retract the paper ‘Virus specific splicing inhibitor in extracts from cells infected with HIV-1’ by D. Gutman and myself published in the 16 September 1988 issue of *Science* (volume 241, p. 1492). The data in that paper should no longer be considered reliable. (Goldenberg 1989: 12)

Most of the Ambiguous Notices that give no description at all of what went wrong do state that the results of the original research cannot be reproduced, but this merely provides a *reason* for why a paper is retracted, not a description of what went wrong. While most of the Ambiguous Notices in our data set give no description of what went wrong, the remaining Ambiguous Notices give very little detail as to what went wrong. For example, the retraction notice [2005 1 14] states:

Critical data in the paper showed direct and specific binding of radiolabeled LPC or SPC to G2A in cell homogenates. The primary data generated by Dr. Zhu for these binding studies are not available for evaluation. (Witte *et al.* 2005: 206)

This notice in part describes what went wrong, that primary data are not available for checking, but we are given so little detail as to what went wrong that there is some reason to suspect that misconduct was involved in the retracted research. Since there is some reason to suspect misconduct, this notice is included in the Ambiguous Notices category.

Our categorization of retraction notices into Honest Error Notices, Ambiguous Notices, and Misconduct Notices rests on the assumption that research teams generally do not disguise misconduct as honest errors.

Honest Error Notices, Misconduct Notices, and Ambiguous Notices vary in their frequency. The most common type of retraction notice in *Science* is the Honest Error Notice. In fact, of the retraction notices published in *Science* in the 35-year period we examined, 55% (42/77) fall in the category of Honest Error Notices.⁵ The second most common type of retraction notice are Misconduct Notices. They account for 27% (21/77) of the retraction notices. The least common type of case is the Ambiguous Notices. They account for 18% (14/77) of the retraction notices.

4. Author Retractions, Editorial Retractions, and Team Retractions

In addition to distinguishing between Honest Error Notices, Misconduct Notices, and Ambiguous Notices, we distinguish between retractions made by *different actors*. As noted in the Introduction, all the retracted papers in our data set were authored by research teams, ranging in size from two to 26. When one or more members of the research team that produced the paper needing retraction signs the retraction notice,

⁵We should note that we take notice [2007 10 26] to be an Honest Error Notice because of a separate piece in *Science* discussing the case (Normile 2007). The case is generally considered to be unusual. The research team was asked to retract the paper by the Committee for Research Integrity of Osaka University School of Medicine. But, as is clear from the piece in *Science* discussing the case, the committee did *not* allege scientific misconduct. It is also worth mentioning that the retracted paper is the second-most cited retracted paper according to www.RetractionWatch.com, and just under 1,100 of its roughly 1,300 citations are post-retraction citations. In two previous papers we categorized [2007 10 26] as an Ambiguous Notice based on the retraction notice alone (Wray and Andersen 2018; Andersen and Wray 2019).

we refer to it as an “author retraction”. Sometimes none of the team members sign the published retraction. These are called “editorial retractions”, as it is the editor of the journal that issues the retraction. We will make one further distinction in the set of author retractions. We use the term “team retraction” to refer to a particular subset of the author retractions. Specifically, we call a retraction a “team retraction” if and only if the retraction falls into category a or b where we define category a and b as follows:

- a. Every team member signs the retraction notice.
- b. All the team members but one sign the retraction notice and the team member that does not sign the retraction is identified as responsible for what went wrong.⁶

Let us look at the distribution of the retraction notices in our data set. Author retractions constitute 83% (64/77) of the retraction notices (see Table 1). Editorial retractions constitute the remaining 17% (13/77) of the retraction notices. Team retractions constitute 66% (51/77) of the total number of retraction notices. In our data set, the author retractions that are not team retractions account for 17% (13/77) of the retraction notices.⁷

It is worth noting that four of the team retractions are unusual. Two team retraction notices, [2002 11 1] and [2006 12 22], are atypical in that they retract more than one paper, but in both cases all co-authors of the papers needing retraction have signed the retraction notice.⁸ Two team retraction notices, [1990 10 5] and [2003 5 30], are signed by two scientists other than the co-authors of the paper needing retraction. These other scientists are from the same lab as some or all of the co-authors of the paper needing retraction and have presumably been involved in the work reported in the retraction notice, reassessing the original results.

Finally, it is worth noting that there has been an increase in the share of editorial retractions over time. However, we suspect that the increase in the share of editorial retractions reflects different editors having different practices rather than a change in the retraction behaviour of research teams, which is our focus in this paper. We have looked at 35 years of retraction notices in the journal *Science*, from 1983–2017. We can divide the data into seven five-year periods: 1983–87; 1988–92; 1993–97; 1998–2002; 2003–07; 2008–12; 2013–17. Only in the latter three five-year periods (2003–07; 2008–12; 2013–17) have there been any editorial retractions at all. From 2003 to 2007, 14% (3/21) of the retractions were editorial retractions, and, similarly, from 2008 to 2012, 15% (2/13) of the retractions were editorial retractions. In the last five-year period, from 2013 to 2017, 50% (8/16) of the retractions were editorial retractions. The abrupt change in the share of editorial retractions between the period from 2008 to 2012 and the period between 2013 to 2017 coincides with a change of editor. Marcia McNutt took over the position of Editor-in-Chief of *Science* in 2013, and she and her successor Jeremy Berg are responsible for all the editorial retractions made in the

⁶For a retraction to fall into category b, the research team that produced the retracted paper must also have more than two members since, otherwise, the retraction would be made by a single scientist, not a team. This condition prevents retractions [1989 1 6], [2005 10 7], and [2010 9 24] from being included in category b.

⁷Most of the team retractions by far fall into category a. In fact, 86% (44/51) fall into category a. The remaining 14% (7/51) fall into category b.

⁸Similarly, the retraction notice [1989 5 12] retracts two papers. The earliest paper was co-authored by four researchers, the later paper by three of the four researchers. But the researcher who only co-authored one of the papers did not sign the retraction. Therefore, we do *not* count [1989 5 12] as a team retraction.

Table 1. Distribution of the retraction notices according to who makes the retraction.

	Author retractions	Editorial retractions
Team retractions	66% (51/77)	
Not team retractions	17% (13/77)	17% (13/77)
In total	83% (64/77)	17% (13/77)

last five-year period 2013–2017. Hence, we suspect that the marked increase in the share of editorial retractions is due to different editors having different practices rather than a change in the behaviour of the research teams responding to the need to retract a publication. In order to test whether the increase in the share of editorial retractions in *Science* in recent years is due to different editors having different practices, we could examine whether there is a similar increase in the share of editorial retractions in other journals in recent years, or whether the share of editorial retractions generally varies more across editors than across time. But this is beyond the scope of this paper.

5. How do research teams handle retractions?

In the remainder of this paper, we will focus on the *team retractions*. In this section, we examine the team retractions in each of the categories of Honest Error Notices, Ambiguous Notices, and Misconduct Notices. For each category, we examine both (i) the frequency of team retractions and (ii) the general behaviour of the teams that make the team retractions. Our assessment of the teams' behaviour is based wholly on the information in the retraction notices. As we shall see, the teams generally behave differently in each of the categories of Honest Error Notices, Ambiguous Notices, and Misconduct Notices.

5.1. The Honest Error Notices

The frequency of team retractions is highest among Honest Error Notices. In fact, 76% (32/42) of Honest Error Notices are team retractions.

In 94% (30/32) of the Honest Error team retractions, the team as a whole takes responsibility for the error in question. By this we mean to say that the team gives a description of the error *it* committed and evaluates the difference the error makes to the conclusions of the retracted paper. No individual team member is identified as responsible for what went wrong.

Retraction notice [2005 3 4] provides an example of an Honest Error team retraction in which the team gives a description of the error it committed and, based on additional research the team has already conducted, the team evaluates the difference the error makes to the original conclusions. The paper needing retraction studied the effect of the bacterial condensin MukBEF on DNA. In the paper, the team had made an inference about the cause of a sawtooth pattern in their force-extension curves. But new research by other scientists had led the team to believe that the sawtooth pattern was in fact caused by something else. They proceeded to conduct experiments that tested their new theory about the cause of the sawtooth pattern. They thus write in the retraction notice:

The conclusions of our paper ... were based on the interpretation of a flat sawtooth pattern in the force-extension curves as a progressive unravelling of compact MukBEF/DNA filaments. However, subsequent experiments done after the paper

appeared suggested that the sawtooth pattern corresponds to the unzipping of the two strands of DNA [Bockelmann *et al.*, 2002]. We now believe that nicks that arose indiscriminately along the DNA molecules from normal pipetting allowed interior biotin and Digoxigenin derivitization of the DNA tether. The combination of interior and terminal labels most likely generated a pulling geometry between the beads that led to the denaturation of the DNA. To test these ideas, we have now performed an extensive set of experiments. (Case *et al.* 2005: 1409)

The team goes on to describe in detail these new experiments.

In just 6% (2/32) of the Honest Error team retractions, the team does not take responsibility for the error in question ([1992 5 15] and [2008 7 25]). The team instead identifies individual team members as responsible for what went wrong. For example, the notice [2008 7 25] retracts a paper by a research team of three scientists. In the retraction notice, the team divides the responsibility for what went wrong among the individual team members. The notice states that, “J. M. Geremia accepts primary responsibility for his large role in acquiring and analyzing the data upon which this paper was based. J. K. Stockton and H. Mabuchi also accept responsibility for failing initially to probe [the] results with sufficient skepticism” (Geremia *et al.* 2008: 489).

5.2. The Ambiguous Notices

The frequency of team retractions is also high among the Ambiguous Notices. Sixty-four per cent (9/14) of the Ambiguous Notices are team retractions.

In 67% (6/9) of the Ambiguous team retractions, the team does not take responsibility for what went wrong and refrains from making a clear statement as to what went wrong. The team identifies one or two individual team members as responsible for what went wrong. In fact, there is only one case in which two individual team members are identified as responsible for what went wrong and in this case one of the two team members is identified as the main person responsible for what went wrong. The case in question is the retraction notice [2004 3 26]. The retraction notice, which is signed by all team members, states: “all data published in the Report were produced by C.C.Q. when he was in G.D.’s laboratory. We cannot presently explain the lack of reproducibility of the data” (Quattrocchi *et al.* 2004: 1974). Note that, in this case, the team does not only refrain from making a clear statement as to what went wrong, but explicitly states that the team does not know exactly what went wrong.

The fact that a team identifies one or two individuals as responsible for what went wrong but refrains from making a clear statement as to what went wrong is not surprising if the team believes that the named individual(s) committed misconduct or acted recklessly but they cannot prove it. In such cases, the team may have legal reasons not to publicly place responsibility for misconduct on the individual(s).

In the remaining 33% (3/9) of the Ambiguous team retractions, the team does not identify any individual as responsible for what went wrong. We will not attempt to interpret these cases as they are few and hard to interpret. The retraction notice [2010 11 12] is one of the three cases. In the notice, the team states that,

To our profound regret, peer inspection of the paper after publication revealed errors and omissions in the information provided on the chemistry underlying array compound synthesis, and the processing of array data obtained. After an investigation, the Ethics Committee of the CSIC in Madrid has recommended the withdrawal of the paper. Given the errors in the paper, and the skepticism about the array that they have generated, we retract the paper. (Beloqui *et al.* 2010: 912)

In this case, there is no admission of misconduct, but there is some reason to suspect misconduct given the recommendation of the ethics committee. At the same time, the team does not identify any individual as responsible for what went wrong.

5.3. The Misconduct Notices

Almost half (48%, 10/21) of the Misconduct Notices are team retractions.

In 90% (9/10) of the Misconduct team retractions, the team does not take responsibility for the misconduct but instead identifies an individual team member as responsible for the misconduct. It is worth noting that in four of the nine cases, the individual blamed did not sign the retraction. But in each of the four cases a university investigation concluded that the individual committed the misconduct.⁹ On this basis, we are assuming that the individual did in fact commit the misconduct. In the remaining five of the nine team retractions even the individual blamed signed the retraction.

The retraction notice [2011 12 2] provides an example of a Misconduct team retraction. The team, which in this case consists of only two scientists, identifies one of the team members as responsible for the misconduct. The team states that,

On 31 October 2011, Tilburg University held a press conference to announce findings of its investigation into possible data fraud on the part of author Stapel. These findings of the university's interim report included fabrication of data in this *Science* paper. Therefore, we are retracting the paper, with apologies from author Stapel. (Stapel and Lindenberg 2011: 1202)

There are two cases that are unusual among the nine Misconduct team retractions where the team does not take responsibility for the misconduct but identifies an individual team member as responsible. In one of these cases, [2002 11 1], which involves the well-known perpetrator Jan Hendrik Schön, the team does not explicitly mention Schön but refers to a report resulting from an investigation which was at the time available online. The investigation found Schön guilty of misconduct and cleared all the co-authors of misconduct (Kennedy 2002).

In another of the Misconduct team retractions, [2007 7 27], the retraction notice identifies not just one but two individual team members as responsible for what went wrong. One of the two team members is identified as the main person responsible for what went wrong. He had been found to have committed misconduct by an investigation conducted by his university. About the other identified team member the retraction notice states: "The corresponding author (R.M.R.) takes responsibility for placing excessive trust in his coworker and for not assuring that a complete set of raw data existed at the time the questions first arose about the paper" (Roberts *et al.* 2007: 450).

So far we have been focusing on the 90% (9/10) of the Misconduct team retractions where the team does not take responsibility for the misconduct but identifies an individual team member as responsible for the misconduct. In the one remaining Misconduct team retraction, [1986 11 28], the retraction notice does not speak of misconduct and does not identify an individual as responsible for what went wrong. To explain the retraction, the team merely writes: "In our view ... [the] data are not reproducible and are incorrect" (Milanese *et al.* 1986: 1056). This case would have qualified as an Ambiguous team retraction had it not been for a separate piece discussing the

⁹In three cases, the investigation is mentioned in the retraction notice ([2005 6 17], [2007 7 27], and [2013 7 26]). In one case, [2007 4 20], the investigation is mentioned in a piece in *The Scientist* discussing the retraction (Zielinska 2007).

retraction in the same issue of *Science* (Culliton 1986: 1069). The co-author who is under suspicion for having committed misconduct was interviewed for the piece in *Science* and admits to having committed misconduct. The piece also describes how an investigation is underway, and that “Reinherz [the senior co-author] and others decline to discuss the case in any detail, pending the outcome of the investigation” (Culliton 1986: 1069). This explains the ambiguity in the retraction notice.

The practices of collaborating scientists as described in this section do *not* fit well with the requirement for author contribution statements insofar as the contribution statements are aimed at distributing the responsibility for the content of a scientific paper among the *individual* team members, that is, to specific individuals. The retractions in our data set are usually made by research teams who often do *not* identify individual team members as responsible for the errors. In 94% (30/32) of the Honest Error team retractions in our data set, *no* individual team member is identified as responsible for what went wrong. Instead, the team takes responsibility for what went wrong. This is not in line with the aim of distributing the responsibility for the content of a collaborative paper among the individual team members, that is, specific individual team members. By contrast, the team behaviour we observe in the Misconduct team retractions *is* in line with the aim of distributing the responsibility for the content of a collaborative paper among the individual team members. In 90% (9/10) of the Misconduct team retractions, the team does indeed identify an individual team member as responsible for the misconduct. Finally, the team behaviour we observe in the Ambiguous team retractions is more ambiguous: some of the cases are in line with the aim of distributing the responsibility for the content of a collaborative paper among the individual team members, other cases not. It is important to note that we have focused on team retractions. Hence, in the case of editorial retractions and author retractions that are not team retractions, it is possible that the retractions fit well with the requirement for author contribution statements in the sense that the retractions identify individual team members as responsible for the errors.

6. Rethinking Authorship Policies

Our purpose so far has been to argue that from a purely descriptive point of view the collaborative practices we have observed do not fit well with the widespread requirement among journals for author contribution statements. Whereas journals work within a framework that is largely individualistic, the way we have observed research teams behave is generally quite different. A retraction is often made by the research team and, in these cases, the team as a whole typically takes responsibility for what went wrong except when the team believes that a team member has committed misconduct. We now want to turn to the normative issue and ask whether the behaviour of the research teams in these situations is to be commended, or whether it would have been better if we had available author contribution statements that divided the responsibility for the content of the collaborative papers among the individual team members. Here again our distinction between the three types of cases is useful.

6.1. The Honest Error Notices

In 94% (30/32) of the Honest Error team retractions, the team takes responsibility for the error in the sense that the team gives a description of the error *it* committed and evaluates the difference the error makes to the conclusions of the retracted paper.

Let us first consider the significance of the research teams taking responsibility for describing the error and evaluating the difference the error makes to the conclusions of the retracted paper. The fact that the research teams describe the error and evaluate the difference the error makes to the conclusions of the retracted paper is clearly very important for science. The research team is in a better position than individual team members working alone to determine where an error occurred in their research and the consequences of the error for their original conclusions. And they are most likely in a better position than other scientists who were not part of the research team. When the original group works together to reassess the original conclusions, they can draw on their different expertise and knowledge of all the aspects of the research reported in the paper needing retraction. Knowing which aspects of a retracted paper are affected by the error is important for the sake of other papers that build on the retracted paper and for the sake of future research. Often the error can be isolated and the paper can retain some value for the advancement of science. For example, to pick a clear case, the data presented in a retracted paper may be valid when an honest error in the interpretation of the data led to the retraction (see, for example, [2015 1 9]). In such cases, the retracted paper has epistemic value because the data presented in the paper are valid (see Andersen and Wray 2019).

In sum, having the original research team work together to determine the nature of an honest error and reassess the original conclusions is valuable from an epistemic point of view. Furthermore, it seems significant that the research team takes responsibility for committing the error in addition to determining the nature of the error and reassessing the original conclusions, as the team does in 94% (30/32) of the Honest Error team retractions.

It is important to note that the research team could take responsibility for determining the nature of an honest error and reassessing the original conclusions without taking responsibility for committing the error.¹⁰ But when the team takes responsibility for committing the honest error, the team has a strong incentive to carefully determine the nature of the error and reassess the original conclusions. Presumably, this is what the scientific community expects of the team. The situation is different if the team does not take responsibility for committing the error and the team, or the editor for that matter, places the responsibility for committing the error on an individual team member. In this sort of case, there is less of an incentive for the team to invest time and energy into determining the nature of the error and reassess the original conclusions, which sometimes requires further research to be conducted. Consequently, the requirement for author contribution statements may be harmful for the advancement of science as it may encourage research teams to place responsibility for committing an error on individual team members and not take responsibility for the error themselves.

A potential negative consequence of the team taking responsibility for committing an honest error is that the scientific community is left with no individual scientist to hold responsible for the error in question. But it is not clear why this is needed in cases of honest errors where the team takes responsibility in the ways described above. Hence, the lack of individual scientists to hold responsible for honest errors does *not* indicate a need for author contribution statements.

¹⁰We thank the anonymous reviewer for pointing out the value of separating the different actions the teams take responsibility for (committing the error; determining the nature of the error; and reassessing the original conclusions) in our discussion.

6.2. The Ambiguous Notices

The cases where it is unclear whether the cause of retraction is an error or misconduct are unfortunate. It seems that the real *epistemic* value of a retraction notice is when there is a clear statement of what has gone wrong, that is, what warrants retracting the original paper in the first place. Clearly, whether the cause of retraction is an error or misconduct matters significantly. It can make the difference between whether the original retracted paper has *some* value for the advancement of science or absolutely *no* value.

The Ambiguous Notices are unfortunate but the relevant question to ask is whether we would have had more clarity as to what happened if we had available author contribution statements that divided the responsibility for the content of the collaborative papers among the individual team members. At least in the typical Ambiguous team retractions it seems that we would not. In 67% (6/9) of the Ambiguous team retractions the team identifies one or two individual team members as responsible for what went wrong. By identifying the responsible individuals the team does what contribution statements *aim to do*. Hence, in these cases, contribution statements are superfluous for the purpose of placing responsibility for what went wrong. It is unfortunate that we do not know what the identified individuals did in these cases. But this is simply because the team and its members, except the identified individual, have no way of knowing exactly what the individual did. If our interpretation of these cases is correct, the team believes that the identified individual has committed misconduct or acted recklessly. Thus, the team has reason not to rely on the individual for an explanation of what went wrong.

In the remaining three Ambiguous team retractions, the team does not identify any individual as responsible for what went wrong (33%; 3/9). These cases are few and it is not clear how to interpret them. It would be unfortunate if the team, by not identifying any individual as responsible for what went wrong, is covering for an individual team member who has committed misconduct or acted recklessly. But even if this were true in all three cases, the cases are atypical and do not provide a strong basis for making a substantial change to authorship practices in collaborative research.

6.3. The Misconduct Notices

Cases of misconduct are different from cases of honest error in terms of the need to hold perpetrators responsible. It is important for the advancement of scientific knowledge that individuals or groups who are guilty of misconduct are held responsible. But in 90% (9/10) of the Misconduct team retractions, the team does not take responsibility for the misconduct but identifies an individual team member as responsible for the misconduct. The research teams are thus willing to expose individual team members who have committed misconduct. So, again, it is not clear what function the contribution statements would have played in terms of placing responsibility for what went wrong. The research teams take care of the sorts of concerns that contribution statements seem designed to address.

7. Conclusion

We have found that collaborative research practices are at odds with the common requirement among journals for author contribution statements. This requirement aims to divide the responsibility for the content of a scientific paper among the individual team members. But we have found that research teams tend to take responsibility for their papers when problems arise and they need to retract a paper. As we report, the retractions in *Science* are typically made by the research team, and in these cases

the team typically takes responsibility for the error unless the team believes that a team member has committed misconduct.¹¹

Furthermore, based on our data on team retractions, it may be unnecessary to require contribution statements. The requirement is designed in part to identify individuals to hold responsible if problems with the collaborative research arise. But we have found that in cases of misconduct or suspected misconduct, research teams generally give us what the requirement for contribution statements aims to give us: they identify the responsible individuals.

In cases of honest error the situation is different. The research teams generally do not identify individuals as responsible for what went wrong. But it is not clear why we need individuals to be held responsible in cases of honest error. Further, we should appreciate the positive implications of research teams working closely together in these cases. Having the original research team work closely together to determine the nature of the error and reassess the original conclusions is valuable from an epistemic point of view. They can aid us in determining what parts of paper are still useful to other researchers.¹² Hence, if we assume that the requirement for author contribution statements encourages more individualistic behaviour in collaborative research, the requirement could even be harmful.

It is worth emphasizing that contribution statements could play a valuable role in placing responsibility when editorial retractions or author retractions that are not team retractions are issued. The value of contribution statements in placing responsibility when such retractions are issued is a topic for future research.¹³

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/epi.2021.25>

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¹¹Interestingly, Bright *et al.* (2018) also argue that the ICMJE recommendations on authorship are inconsistent with scientific practice but in a very different sense. They argue that it is unrealistic to require, as the recommendations do, that collaborators agree to the *propositions* they assert in their joint publication. They thus write, "from an epistemic perspective, it seems too strict of a requirement to say that every scientist in a collaboration has to agree to a particular proposition for them to be able to assert it as a group" (Bright *et al.*, 2018: 245).

¹²Focusing on massive collaborations, Huebner *et al.* (2018: 107) deny that a team as a whole can be responsible for a paper the team has produced. Our data cannot speak to teams of the sort that concern Huebner *et al.* (2018), teams with hundreds of members. In our data, the teams that produced the retracted papers range in size from two scientists to 26 scientists. We leave open the possibility that massive collaborations create special problems when something goes wrong and they need to retract a paper.

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