

Doing the Right Thing: A Qualitative Investigation of Retractions Due to Unintentional Error

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Abstract Retractions solicited by authors following the discovery of an unintentional error—what we henceforth call a “self-retraction”—are a new phenomenon of growing importance, about which very little is known. Here we present results of a small qualitative study aimed at gaining preliminary insights about circumstances, motivations and beliefs that accompanied the experience of a self-retraction. We identified retraction notes that unambiguously reported an honest error and that had been published between the years 2010 and 2015. We limited our sample to retractions with at least one co-author based in the Netherlands, Belgium, United Kingdom, Germany or a Scandinavian country, and we invited these authors to a semi-structured interview. Fourteen authors accepted our invitation. Contrary to our initial assumptions, most of our interviewees had not originally intended to retract their paper. They had contacted the journal to request a correction and the decision to retract had been made by journal editors. All interviewees reported that having to retract their own publication made them concerned for their scientific reputation and career, often causing considerable stress and anxiety. Interviewees also encountered difficulties in communicating with the journal and recalled other procedural issues that had unnecessarily slowed down the process of self-retraction. Intriguingly, however, all interviewees reported how, contrary to their own expectations, the self-retraction had brought no damage to their reputation and in some cases had actually improved it. We also examined the ethical motivations that interviewees ascribed,

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retrospectively, to their actions and found that such motivations included a combination of moral and prudential (i.e. pragmatic) considerations. These preliminary results suggest that scientists would welcome innovations to facilitate the process of self-retraction.

Keywords Integrity · Error · Misconduct · Retractions · Corrections · Moral reasoning

Introduction

Formal retractions of scientific publications are a relatively recent innovation in publication practices that is rapidly growing in importance. The number of high-impact biomedical journals that have a retraction policy has grown from less than 21% in 2004, to 65% in 2014 (Resnik et al. 2015a). During the same period, the number of retractions has increased very rapidly, a phenomenon that is demonstrably not the symptom of increasing misconduct but rather the effect of a growing ability and willingness of journal editors to retract (Fanelli 2013).

According to the most accurate estimate conducted to date, the majority of retractions are due to scientific misconduct or other intentional breaches of research ethics, even when the text of retraction notes suggests otherwise (Fang et al. 2012). However, at least 20% of retractions can be unambiguously attributed to unintentional errors or methodological flaws and appear to have been solicited by the authors of the retracted paper (Fang et al. 2012). This phenomenon of “self-correction by retraction” has exceptional potential as a means to preserve the integrity of the literature and is likely to increase in the future, following recent proposals and initiatives to encourage it. Proposed innovations of retraction policies include new, “retraction and replacement” formats (Heckers et al. 2015), proposals of a new “withdrawal” category for honest retractions (Pulverer 2015), and distinguishing retractions based on their authorship status in order to mark out retractions solicited and signed by all authors as “self-retractions” (Fanelli 2016). There is currently no standard terminology to distinguish different types of retraction. Therefore, we will henceforth use the term “self-retraction” to indicate any retraction that was not due to scientific misconduct and that was solicited or at least endorsed by the authors of the publication being retracted. We prefer to use this term because it is simpler and less value-laden than alternative definitions (such as “virtuous retractions”) but we do not intend, by using it, to express a technical or ethical qualification of the cases examined in this study.

A large and growing literature is dedicated to understanding scientific misconduct, its underlying causes, consequences and possible ways to prevent it (e.g. Williams and Wager 2011; Gross 2016). Numerous studies have also been conducted on retractions, under the assumption that retractions are proxies for scientific misconduct (e.g. Fang et al. 2012; Fanelli et al. 2015). To the best of our knowledge, however, no study to date has focused on self-retractions and the values and integrity that are arguably expressed by their authors. This study aimed at filling this gap by collecting information on the circumstances that lead authors to request

a self-retraction, on the experience of self-retracting, and on the personal and ethical motivations of authors who self-retract.

Our initial hypothesis, indeed the main hypothesis that inspired this study, was that authors of a self-retraction might set for themselves particularly high standards of research integrity. We assumed that these authors, in requesting a self-retraction, had expressed highly internalized ethical and moral norms. In order to assess the moral value and ethical standing of a person's actions, it is not sufficient to describe what the person has done, because we "must take into account what was motivating the person as he did it" (Frankfurt 2001). Prudential (i.e. pragmatic) and moral reasoning, in particular, are two key dimensions to consider in ethical decision making (Hilhorst et al. 2006). The options that are available to an ethical agent, as well as the potential costs and benefits in pursuing that action are pivotal components of a decision making process, and understanding these conditions was a major objective of our study.

Given the rarity of self-retractions and the scarcity of background literature on this topic, our study was designed as a maximally informative, qualitative investigation. By conducting 14 semi-structured interviews, we documented individual experiences of self-retraction, as retrospectively recounted by individuals directly involved in them. Our results offer preliminary insights into a new and poorly studied modality of scientific self-correction and may inform future research and initiatives to promote integrity in research and publication.

Methods: Selection of Cases, Invitation and Questionnaire

Selection of Cases

Scientific research is increasingly international and collaborative (Fanelli et al. 2015) but research policies and academic cultures vary greatly across countries (e.g. Resnik et al. 2015b; Vasconcelos et al. 2014) in ways that may affect research practices and in particular the likelihood to retract and correct papers (Fanelli et al. 2015). To limit the confounding effects of national culture and misconduct policies, we restricted our analysis to cases of self-retractions from authors working in Northwestern European countries. The Research Ethics Committee of Erasmus MC Rotterdam approved the study (MEC-2015-532).

Following previous methods to retrieve retractions (Fanelli 2013), we searched the Web of Science core collection database for records marked as "correction" or "correction, addition" that contained the word "retraction" in the title. The search was limited to retraction notices published in the year 2010 or later. In an initial phase of the study, the search was limited to retraction notes for which at least one of the co-authors was based in the Netherlands or Belgium. To increase the sample size, geographical criteria were later extended to authors based in the United Kingdom, Germany and Scandinavian countries. We focused on these countries because they were likely to represent a relatively homogeneous socio-cultural group (i.e. scientifically active and North-Western European) and because scientists in

these countries generally speak fluent English, ensuring sufficiently clear communication during the interviews.

Two authors (DF and MHi) independently examined the text of retraction notes, then compared their opinions and compiled a list of retractions that were most likely due to honest error. The text of retraction notes was shown by previous studies to be often non-transparent (Fang et al. 2012), however, our sampling strategy is likely to have captured all available self-retractions. This follows from the fact that retraction notes tend to under-report the actual occurrence of scientific misconduct, concealing it behind euphemisms that make the case appear as an unintended error (Fang et al. 2012), whilst the opposite case—a retraction note that suggests the occurrence of scientific misconduct when an unintentional error had occurred instead—is extremely unlikely. Therefore, our list of potentially relevant cases could have included retractions that would later turn out to be linked to scientific misconduct, but not vice versa. All of the authors that were interviewed confirmed that the retractions in question were not due to scientific misconduct. Given that none of our interviewees had been subjected to a misconduct investigation, and that they all had spontaneously cooperated with the journal to issue what they hoped would be a correction (see results), we consider it very unlikely that any of our interviewees had lied and that any of the cases included in this study represents an instance of concealed scientific misconduct.

Contact and Interviews

An invitation to participate to the study was emailed to the corresponding author of each of the self-retracted papers we had identified. If an author had not responded to the initial invitation, he/she was sent a reminder by email and further attempts were also made to contact other co-authors of the self-retracted study.

Interviews were conducted in person in eight cases, and via Skype in the remaining six cases. All interviews took place between May and October 2015. On average, the interviews lasted 39 min, and were conducted by MHo. Interviews were guided by semi-structured questionnaires (see “[Appendix 1](#)”), which consisted in a set of open questions that focused in particular on four main themes:

1. Circumstances underlying the retraction: what happened and what led the author(s) to notify the journal and to retract the paper.
2. Communication with the journal: what did the correspondence with the journal consist of, and what difficulties, if any, were encountered.
3. Communications with colleagues: who did the interviewees consult and get support from, how did co-authors and other colleagues respond to the event, and eventual disagreements regarding the course of action to take.
4. Lessons learned: whether and how did the interviewees change their research practices following the experience of self-retraction and what general insights, if any, did they learn from the experience.

At the end of each interview, we presented respondents with a list of 20 statements and encouraged them to summarize their beliefs and express opinions regarding honesty and research integrity, using a Likert-scale. The list of questions and Likert-based questionnaire were initially tested in three pilot interviews (jointly conducted by MHo and MHi), and revised based on that experience.

The text of interviews was transcribed and translated, when necessary, in English. A list of relevant topics for analysis was compiled and agreed upon by MHo, MHi, DF. In addition to the four themes mentioned above, this list of topics included: motivations, circumstances, negative and positive consequences, vulnerabilities, obstacles, reaction of the scientific community, remarkable quotations. Transcripts of the interviews were coded independently by MHo and MHi, following this scheme, and results of each interview were subsequently discussed by all authors of this study in order to reach a common understanding and interpretation of the interviews and the experience described by the interviewees. Transcripts' coding and analysis was conducted using the NVivo software v. 11 (QSR International 2015).

Results

Our screening and selection process identified 25 papers that qualified as self-retractions. We contacted one or more of the co-authors of each of these papers, for a total of 35 co-authors. Of these, 16 were corresponding authors and 19 were first authors, six of which were PhD students at the time when the retracted paper was published. Of all the individuals contacted, 19 never responded to our initial request and subsequent reminders, two declined to participate, and the remaining 14 agreed. Nine of the latter were corresponding and/or last authors of the retracted paper, and five were first authors. Our final sample therefore included 14 self-retractions, 11 of which were from journals in the biomedical sciences and the rest from journals in other natural sciences.

Table 1 summarizes the circumstances leading to the self-retraction and other salient details that in our analysis captured the essence of the experiences and perspectives of each interviewee. Table 2 provides interviewees' responses to our Likert-scale questionnaire. Below, we examine in greater detail specific themes that emerged in our interviews and we offer an analysis of the ethical worldview of our interviewees.

Motivations and Circumstances

The first, and rather unexpected finding of our study was that only three of our interviewees had originally intended or agreed to retract their paper. In all other cases, the interviewees had contacted the journal to request a correction, quite independently of how the flaw in their publication had been discovered (see Table 1). In all such cases, the decision to retract the paper had been made by journal editors. Most interviewees still disagreed with the journal's decision to issue

Table 1 Summary of key characteristics of cases included in the study and salient quotations from each interview

Interview	Author initially requested	How error was discovered	Would error have been discovered otherwise?	What motivated the decision to self-report	Concerns prior to retraction	Difficulties encountered when retracting
1	Correction	First author, whilst reproducing the study	No	“It is better to report something yourself than to have it discovered by someone else”	“It was my first experience of authorship and I didn’t feel I could do it on my own”	“I was not in contact with my coauthors anymore”
2	Retraction	A PhD candidate, who worked in the same lab and was not an author of the paper, re-analyzed the data in a new project	No	“You cannot live with a lie.” “What about all the post-docs who might do research on the basis of false information?”	“I had just started my own research group and people whom I respected told me that a retraction would end my career.” “I Googled ‘retraction’ and all the examples that I found were examples of fraud” “We were worried about our reputation”	“That was a very stressful period”
3	Correction	One of the coauthors discovered the error when inspecting the raw data	No	“Quality and honesty of research were among our concerns.” “Others who use our research should have data that is reliable and without flaws”	“We were very concerned about our reputation.” “We lost confidence in our methodology and feared that previous papers might be incorrect too”	“The whole process took a long time and we were treated in an unpleasant way by the journal.” “It was time consuming and caused a delay in the Ph.D. project of a student.” “We had to defend ourselves against allegations of fraud” “The editor seemed inexperienced.” “We were stressed”
4	Correction	First author discovered the error after finishing his/her PhD project	No	“We didn’t want to publish incorrect information. We thought that ethics weighed more than our own reputation.” “We didn’t want to do sloppy science and felt that it was our responsibility to retract”		

Table 1 continued

Interview	Author initially requested	How error was discovered	Would error have been discovered otherwise?	What motivated the decision to self-report	Concerns prior to retraction	Difficulties encountered when retracting
5	Correction	One of the coauthors, employed by a company that had contributed methods to the study, discovered the flaw	No	<p>"We couldn't redo our study, the best we could do was to tell our readers: listen, what we published is wrong and you shouldn't cite us."</p> <p>"We wanted to publish things very transparently"</p>	<p>"[A researcher's] entire scientific CV was being questioned."</p> <p>"I was afraid that although we had been honest, someone could see us as guilty of fraud"</p>	<p>"We had no experience with retractions and this information can't be found in books, so we had to find out by ourselves what the best course of action was"</p>
6	Correction	An independent research group discovered the error whilst trying to reproduce the study	Yes	<p>"I wanted to make myself feel better."</p> <p>"I wanted to show that I clean up after any mess that I make"</p>	<p>"Controversies came to light when the first author, who was a PhD student at the time of publication, had already taken up a postdoctoral position"</p>	<p>"There was a communication drop within the group for some time"</p>
7	Correction	The error was discovered by a representative of the company that sponsored the study	Yes	<p>"There was no other option."</p> <p>"We were responsible for the integrity of our data"</p>	<p>"None of us had any experience with a retraction and we were all scared"</p>	<p>"Some researchers who were worried about their future career were resisting [the idea of retracting]"</p>
8	Correction	The authors of the study tried to reproduce results using a new method developed by another group	No	<p>"We didn't want to have a publication containing wrong information."</p> <p>"I would have been unable to sleep at night, if I had not communicated the error to the journal"</p>	<p>"Retraction is mainly associated with fraud and ours was not a case of fraud.[...] we had simply followed the science available at the time"</p>	<p>"It was not clear [to us] when an author was expected to retract"</p>

Table 1 continued

Interview	Author initially requested	How error was discovered	Would error have been discovered otherwise?	What motivated the decision to self-report	Concerns prior to retraction	Difficulties encountered when retracting
9	Correction	First author discovered the error whilst working on a new project. The study was replaced by a new version, which was published as a new, peer-reviewed article	No	<p>"We wanted everything to be right."</p> <p>"Our data might be used in a meta-analysis"</p>	"One of the coauthors was worried and we had some doubts about the fairness of the peer-review process"	<p>"The journal was not very experienced with retractions and it took them a long time to respond."</p> <p>"When we realized that we had to pay the processing fees again, some of us doubted if this was really worth doing"</p> <p>"One of the co-authors felt very sad about it"</p>
10	Correction	First author discovered the error	No	<p>"We couldn't talk freely about our paper, because it contained wrong information."</p> <p>"I couldn't live with myself"</p>	"One of the coauthors was stressed"	"We invited the whistle-blower to a meeting to demonstrate our methods and the reliability of our research but he didn't show up."
11	Retraction	A whistle-blower contacted the journal and reported the error. The group was accused of research misconduct before any investigation had been carried out	Yes	<p>"Due to the emotionally heated atmosphere, I decided to retract and deal with the issue properly"</p>	"By retracting, other people might speculate that our data was incorrect"	"Communication took a long time"
12	Correction	The senior author discovered the error right after the publication of the article	Yes	<p>"I wanted to comply with the rules of Royal Dutch Academy for Science."</p> <p>"I think it is unethical to stand on conclusions that have no fundamental support"</p>	"One of our competitors had made lots of false allegations about the paper and retracting it would validate them"	"The first author was shocked and stressed"

Table 1 continued

Interview	Author initially requested	How error was discovered	Would error have been discovered otherwise?	What motivated the decision to self-report	Concerns prior to retraction	Difficulties encountered when retracting
13	Retraction	The department had acquired new equipment and the group decided to use it to reproduce their previous results	No	"It would have been very hypocritical to criticize others' flawed published results and not to be honest about our own"	"We were worried that a retraction would cast doubts on our past publications"	"Communication with the journal was irritating"
14	Correction	The error was noticed by a colleague, who was not an author of the study	Yes	"I would feel very bad about having a publication containing wrong information, which other colleagues might read"	"I was concerned about my reputation"	"Communication with the journal took a long time." "Our paper had to go through the review process again"

Table 2 Responses of interviewees to the Likert questionnaire

Statements	SA	A	N	D	SD	Median
Circumstances have forced me to inform the journal	8	1	1	1	3	SA
All errors and mistakes in scientific publications should be notified to journals	12	2	0	0	0	SA
In my case, it was an option <i>not</i> to inform the journal	4	1	0	0	9	SD
Honest reporting to the journal was my only consideration when I decided to retract the paper	9	3	2	0	0	SA
I regard the way in which we behaved, when deciding to report to the journal, as exemplary	9	2	3	0	0	SA
At first it was unclear what conclusion my co-authors and me would reach: to report or not to report to the journal	2	0	1	0	11	SD
I feared the consequences of not reporting to the journal	3	2	1	3	5	D
My co-authors and me were in full agreement about the right course of action to take	8	4	1	1		SA
I made up my own mind about what actions to take independently from my colleagues	8	1	3	1	1	SA
In deciding what to do, I followed my institution's code of conduct	5	0	2	0	7	D
Our institutional policies strongly support honest behaviour in research	11	0	3	0	0	SA
Educational activities in my institution helped me to find the right course of action	5	1	4	0	4	N
Colleagues not involved in the project convinced me of the necessity to retract/report to the journal	0	1	1	2	10	SD
It is important to work in a research environment that is characterized by open and transparent communication	14	0	0	0	0	SA
I work in a research environment where accurate and conscientious reporting of research results is expected and encouraged	12	1	0	1	0	SA
Most incorrect and flawed articles cause hardly any harm	0	0	0	3	11	SD
Retracting a scientific article causes severe harm to co-authors' reputation	0	0	6	1	7	D/SD
The possible negative effects on a researcher's career must be taken into account when deciding upon retracting	0	0	1	0	13	SD
The identity of the co-author/s who were responsible for a mistake must be taken into account when deciding upon retracting	0	0	0	1	13	SD
Honesty and integrity can only be expected when fundamental changes in the research system are effectuated	6	3	2	0	3	A

Each cell reports the corresponding number of respondents

SA—strongly agree, A—agree to some extent, N—neutral (neither agree nor disagree), D—disagree to some extent, SD—strongly disagree, median—category reflecting the median response

a retraction instead of a correction, because they maintained that the errors being amended did not affect the main conclusions of their study. In two cases, interviewees said that they had requested a correction simply to inform their colleagues about methodological advancements: they had re-analyzed their study's data with new and improved methodologies, found that results based on the new method were substantially different from those previously reported, and therefore

wanted to issue a correction to draw their colleagues' attention to the obsolescence of previous methods.

Despite only intending to issue a correction, several interviewees reported having hesitated to inform the journal and having carefully weighted the potential consequences of reporting versus not reporting the error they had discovered. This suggests that even issuing a correction, i.e. a practice that is generally assumed to be inconsequential for a scientists' career, might be perceived as a costly action that is potentially damaging to one's reputation. Whilst the majority of respondents agreed that all errors should be notified to journals and that they were compelled to take action, five of them agreed that they would have had the option of not informing the journal at all and that they would not expect to suffer any consequences from such inaction (Table 2). In accordance with this perception, almost all interviewees believed that self-retractions are likely to be the exception rather than the rule, and that the literature abounds with articles that are seriously flawed and never corrected or retracted. One of our interviewees went as far as to say that: "honestly, looking back, I think that 10–20% of the papers that listed me as a co-author are good candidates for retraction".

Obstacles to Correcting and Retracting Honest Errors

Our interviewees reported a variety of factors that might discourage authors from retracting their own papers (Table 1). The two hindrances most commonly mentioned in interviews were the perception of a stigma attached to retractions and difficulties in communicating with journal editors.

Stigma of Retraction

Almost all interviewees described the period preceding the retraction as stressful to some degree. Experiences that were recalled typically included losing sleep and spending days lost in fearful thoughts, considering the retraction as a depressing scientific failure and feeling insecure and concerned about one's future professional standing. Some believed that retracting one of their publications would cast doubt on their entire publication record, possibly leading to the loss of their scientific reputation, grants or even their academic degrees.

All interviewees had sought the advice and support of people beyond their co-authors. In virtually no case, however, was this advice recalled as having played a determining role in the decision to notify the journal. Indeed most respondents reported having made up their own minds about what to do (Table 2). In a few cases, a statistician or expert scientist had been asked to provide an independent technical assessment of the problem. Most commonly, however, interviewees had sought advice exclusively from individuals they felt they could personally trust, such as friends, supervisors and personal mentors. Institutional figures, such as department directors, were typically informed or included in the decision process only at later stages.

Whilst in most cases interviewees had been recommended by their colleagues to notify the journal, some interviewees were advised to do otherwise in order to avoid professional damage.

Concerns for possible reputational damages appeared to be reinforced by experiences with the mass media. Three interviewees, in particular, complained about their communication with journalists and bloggers who covered their case. They reported being made to feel uncomfortable by the questions they were asked. In their own words, they reported being asked “negative questions”, getting the impression they were seen like “criminals” who “had to defend themselves against fraud allegations”. The sense of distrust towards the mass media had been reinforced by what appear to be questionable journalistic practices. These reportedly included publishing email conversations or other sensitive information without the interviewees’ explicit consent.

Communication with Journal Editors

Many authors expected rapid, empathic and detailed responses from journal editors, but reported receiving short, unsympathetic and sometimes unpleasant ones instead. Journal editors were also expected to offer guidance on the process and procedure, but their response was sometimes perceived as ineffective. The poor support offered by journal editors was generally attributed to inexperience, rather than intentional hostility, but it had a discouraging effect nonetheless. A few interviewees also complained about the constraints imposed on retraction notices. The length of retraction notices was generally felt to be insufficient to offer an adequate and informative explanation of what had gone wrong. In the opinion of some interviewees, providing more details could help other researchers avoid similar errors.

Decisively positive experiences, however, were recalled by the three interviewees who were senior and highly respected academics. Quite unlike the other, less prominent interviewees, they described their communication with the journal in overtly positive terms, having found journal editors to be very cooperative and responsive and the whole process to be smooth and straightforward. All three of these interviewees had had much experience in communicating with journal editors—some had even been journal editors themselves—and were personally acquainted with the editors that handled their case.

Unnecessary Fears

All interviewees reported that any concerns they had about suffering a reputational damage turned out to be unfounded. Contrary to what they feared and to what (in some cases) even their colleagues had predicted, they did not experience any negative consequences from their retraction. This is well illustrated by responses to our questionnaire, according to which none of our interviewees agreed with the claim that retraction of an article harms the reputation of the article’s authors (Table 2). “It hasn’t affected our career as such that I can see in terms of difficulty at publishing papers. We neither saw any referral to the retraction in any reviews nor have we seen any direct mention of that paper” explained one interviewee. Indeed,

decidedly positive reactions were experienced by several interviewees who ultimately felt proud of having self-retracted a paper. Some reported receiving compliments from colleagues, in private as well as in public, including at scientific conferences. The experience of senior academics was no exception: they too were openly complimented for their honesty and, in two separate cases, had received invitations to speak at conferences to share their experience of self-retraction. One interviewee reported that the self-retraction appeared to have had a positive impact on the acceptance of later work: “Shortly after the retraction, I submitted another paper and, after it was reviewed, one of the remarks was literally: this researcher has recently retracted a paper, which shows that she is precise and considerate.”

Moral Reasoning Behind Corrections and Self-Retractions

Discovering motivations and moral reasoning of interviewees is a complex matter that requires an analysis of their fundamental beliefs. Several models pay attention to particular aspects of prudential and moral reasoning (Hilhorst et al. 2006). We can summarize the moral reasoning of our participants based on three perspectives that always play a role to various degrees: values, principles and consequences.

One core value referred to by the participants for notifying the journal is ‘personal honesty’. Multiple interviewees made statements such as “I could not live with myself if I was not open about it”, which reflect a view of one’s moral self and can be seen as a form of virtue ethics, where one sees one’s life and career as a continuous narrative that should be lived with certain virtues. “You should not lie, and always be honest” reflects a form of Kantian duty ethics, a deontological approach that commands the actor to perform the right act, regardless of consequences or interests.

Another core value that was frequently mentioned was ‘scientific honesty’. “Scientific truth should be our only concern, scientific reporting should be reliable”, said one participant, reflecting a combination of professional view (as opposed to a personal one), and a principled approach. Truthfulness and reliability are seen as principles that should guide our decisions.

These ethical aspirations of respondents were clearly reflected in responses to the questionnaire. Whilst a proportion of the interviewees declared that they did have the option not to take action and that such inaction would not have entailed consequences for them, most or all of them agreed that all errors should be corrected, and described their actions as exemplary and guided by personal honesty (Table 2).

Another ethical perspective takes consequences into account, i.e. ‘not notifying the journal may harm others’, a statement with which all respondents agreed (Table 2). Harm is done whenever others base their scientific work on flawed publications, or try to replicate their results and waste time and money. These consequences can be seen as relevant moral circumstances, which are of particular importance in fields in which resources are scarce, research is expensive, and human health is directly at stake. Consequentialist reasoning, however, was also frequently expressed in considerations such as “others in my surrounding knew already of the error”, “it could end up in a nasty situation” or “others may find out later”. This

reflects rather a prudential, even opportunistic form of reasoning. The same is true for purely self-regarding consequences: “by not notifying the journal I could not have stayed in the field and be credible”. In most cases notifying the journal is apparently based on well-considered judgments that take into account moral as well as prudential reasons, by weighing facts, circumstances, options and their potential consequences (cf. Rawls’ model of reflective equilibrium).

Some of the considerations made by the authors can be taken as a (rational, logical, reasonable) support for the decision to notify the journal, justified by their particular circumstances. Using various models of moral reasoning, considerations can be qualified in different ways. Indeed, these circumstances can be seen as ‘warrants’ (Toulmin et al. 1979) for contacting the journal or ‘circumstantial evidence’ (Rawls 1971) or ‘salient features of a situation’ (Nagel 1986).

Discussion

We aimed to gauge some qualitative insights into a new, rare but growing phenomenon. Our results should be considered preliminary, due to a number of largely unavoidable limitations. We could only identify a small number of potentially relevant cases, i.e. authors of papers that had explicitly been retracted due to an honest error and who were willing to be interviewed about it. Moreover, these cases represented a broad range of research topics, methodologies, countries as well as kinds of research institutions (i.e. public as well as private). This diversity makes each interview unique in many details and thus hampers broad generalizations of our findings. Moreover, we could only interview researchers who, after much deliberation and consulting with authors and colleagues, eventually decided to notify the journal of an error. As even some of our interviewees suggested, there are probably many researchers who, despite discovering important errors in their publications, eventually decide not to take any action. Our results, therefore, are based on an intrinsically self-selected group of individuals.

One of our objectives, that of understanding the ethical reasoning and perspectives of self-retracting authors, was unavoidably limited by what is perhaps the most important finding of this study, which is that most interviewees had not acted with the intention to retract the paper but merely to correct it. Would they have contacted the journal if they knew that they would end up having a retraction linked to their name? This is a question we are unable to answer, because we only know interviewees’ perception in hindsight: they all confirmed that they did not regret informing the journal of their error, that it had to be done, and that it was the only right thing to do. Even the decision to request a correction was reportedly made after careful reflection. This reflection involved moral as well as prudential considerations, expressing a tension between the imperative to follow internalized ethical principles and more pragmatic assessments of the consequences of not doing so—consequences for self, for colleagues who cite their work, for science and for the community at large. Similar perspectives and lines of reasoning might underlie decisions to self-retract. The current imbalance between perceived costs, benefits

and ethical and moral value of correcting and retracting one's own scientific papers helps explain why self-retractions are still a relatively rare occurrence.

Despite its preliminary nature and limitations, our study revealed remarkable similarities in the experiences of scientists who underwent the process of self-retraction, which support multiple conclusions and recommendations that we discuss below.

The majority of participants associated retractions with a stigma and many, especially those at an early stage of their careers, had been deeply concerned that even a retraction due an honest error would have a negative impact on their professional reputation. These concerns were reinforced, in some cases, by mass-media that, at least in the subjective impression of interviewees, seemed keen on characterizing their case as one of misconduct. These concerns, however, invariably turned out to be unfounded, and all of our interviewees reported receiving positive reactions from the scientific community. This latter finding corroborates recent studies suggesting that authors of a self-reported retraction benefit from a boost in citations (Lu et al. 2013).

The experiences documented in our study bring comforting news for all researchers who might discover flaws in their previously published work. However, they also vividly illustrate how the system of scientific publication and communication could do a lot more to recognize and reward the integrity expressed by scientists who wish to amend their flawed articles. Doing so might require something as simple as ensuring that only honest retractions are signed by all authors and recognized as new publications (Fanelli 2016). The experiences of our interviewees strongly suggest that the scientific community would benefit from any intervention to mark out self-retractions and is culturally prepared to praise and reward authors who retract their own work.

Improvements might be needed not only for the policies of journals but also for those of institutions. The majority of participants reported how, even though they were aware of the existence of an institutional code of conduct on matters of research integrity, they had not found this code useful to their case, and had preferred to follow their own conscience (Table 2). Indeed, the fact that most interviewees had not foreseen the fact that their paper needed retracting suggests that they were not familiar with (or had not been able to fully understand) journal policies and international guidelines on retraction and correction. Given the diverse provenance of our interviewees, these claims are difficult to generalize. However, they suggest that current institutional codes of conduct and journal policies are either inadequate or inadequately promoted amongst researchers. Whilst many respondents had not referred to their institution's code of conduct, they all reported to have found the educational activities of their institute helpful (Table 2). These findings support the view that scientific integrity can be treated as a virtue that is acquired by training and education, and cannot simply be secured with strict codes and regulations (Consoli 2008).

Our findings also underscore the importance of good mentorship in fostering research integrity. Although none of the interviewees reported strong disagreements among co-authors over the need to correct and eventually retract their joint publication, senior authors generally appeared to take the lead throughout the

process. Junior authors (PhD students and Post-docs) appeared to assume a more passive role and to rely on their mentors' guidance. The passivity of young researchers may be explained by multiple factors. Junior researchers are academically powerless as well as inexperienced and are therefore in a vulnerable position. Senior researchers, our results suggests, did indeed benefit from their longer experience, personal connections and higher academic status. Moreover, junior researchers might not have yet internalized norms of scientific integrity and might therefore be in need of ethical leadership. All these factors underscore how good mentorship is essential to ensure the professional development and ethical maturation of future scientists.

In conclusion, our results offered a very preliminary window into a phenomenon, that of self-retraction, that epitomizes scientific integrity and yet has been poorly studied and documented to date. Future research could build upon these results both qualitatively, by elaborating and expanding on the various themes that have emerged from our interviews, as well as quantitatively, assessing for example to what extent the problems documented by our study represent general obstacles that impede an efficient amendment of the literature. We believe that the lack of attention paid to such cases is manifest not just in the scarcity of scholarly literature on the subject but also in the overwhelming attention that the media as well as course curricula on the Responsible Conduct of Research (RCR) pay to egregious cases of scientific misconduct (e.g. Baylis 2004). We believe that exemplars of virtuous conduct, including stories of researchers who corrected or retracted their own papers, should figure more prominently in the popularization of science and should be presented in RCR curricula as an inspiration for future scientists.

Appendix: Questionnaire—Retraction Project

1. What exactly happened?

Follow up-questions:

- What led to the idea that something was wrong, was it clear at first?
- When was this moment?
- Who were involved at that very first moment?
- When were the other co-authors notified?
- How did the co-authors respond?
- How did the debate unfold: did the team discuss the matter.
- How long did it take to make a decision, how much time from initial doubts to sending the retraction letter?

2. Can you describe your correspondence with the Journal?

Follow up-questions:

- Which author(s) did the request? On behalf of all the co-authors? (If not, why?)

- How did you describe to the Journal what was wrong? Did you elaborate on the circumstances of the case?
 - What did you ask (article retraction or just a correction)?
 - What was the Journal's response to the request?
 - How long did it take before a decision was made?
 - What reason did the Journal give for retraction?
 - Do you think this response was adequate, as it should be?
 - Do you think the communication with the Journal was satisfactory?
3. How did your communication with your colleagues and others evolve?
Follow up-questions:
- With which persons did you talk in the first place? (Co-authors; research leader; colleague; a friend perhaps outside the work environment)
 - Who were involved in the decision to inform the Journal (solely co-authors or also others?)?
 - Were all in agreement with each other, had you/others to be convinced?
 - What was the final, decisive motivation to inform the Journal, what was your main concern?
 - What if you did not notify the journal, what would have been the consequences?
 - If objections were raised and concerns expressed (against informing), what were these?
 - How long did it take from the idea that something was wrong to informing the Journal?
 - What were the obstacles, what were the driving factors?
4. What did you learn? What can the scientific community learn from this experience?
Follow up-questions:
- What would encourage researchers to behave the way you did?
 - How can, in your perception, honest research and scientific integrity be facilitated and promoted?
 - What are, in your perception, the main obstacles and threats to research integrity, i.e. honest reporting?
 - Which factors, motives and circumstances, have led in your case to this outcome (request for retraction)?
 - Have there been any harmful consequences?
 - In retrospect, do the positive consequences (of informing the Journal) outweigh the negative consequences?
 - What were these consequences in your case?

References

- Baylis, F. (2004). The Olivieri debacle: Where were the heroes of bioethics? *Journal of Medical Ethics*. doi:10.1136/jme.2003.005330.
- Consoli, L. (2008). The intertwining of ethics and methodology in science and engineering: A virtue-ethical approach. *Interdisciplinary Science Reviews*. doi:10.1179/174327908x366923.
- Fanelli, D. (2013). Why growing retractions are (mostly) a good sign. *PLoS Medicine*. doi:10.1371/journal.pmed.1001563.
- Fanelli, D. (2016). Set up a 'self-retraction' system for honest errors. *Nature*. doi:10.1038/531415a.
- Fanelli, D., Costas, R., & Larivière, V. (2015). Misconduct policies, academic culture and career stage, not gender or pressures to publish, affect scientific integrity. *PLoS ONE*. doi:10.1371/journal.pone.0127556.
- Fang, F. C., Steen, R. G., & Casadevall, A. (2012). Misconduct accounts for the majority of retracted scientific publications. *Proceedings of the National Academy of Sciences*. doi:10.1073/pnas.1212247109.
- Frankfurt, H. (2001). The dear self. *Philosophers' imprint*. <http://www.philosophersimprint.org/001000/>. Accessed 18 April 2016.
- Gross, C. (2016). Scientific misconduct. *Annual Review of Psychology*. doi:10.1146/annurev-psych-122414-033437.
- Heckers, S., Bauchner, H., & Flanagan, A. (2015). Retracting, replacing, and correcting the literature for pervasive error in which the results change but the underlying science is still reliable. *JAMA Psychiatry*. doi:10.1001/jamapsychiatry.2015.2278.
- Hilhorst, M. T., Kranenburg, L. W., & Busschbach, J. J. (2006). Should health care professionals encourage living kidney donation? *Medicine, Health Care and Philosophy*. doi:10.1007/s11019-006-9002-x.
- Lu, S. F., Jin, G. Z., Uzzi, B., & Jones, B. (2013). The retraction penalty: evidence from the web of science. *Scientific Reports*. doi:10.1038/srep03146.
- Nagel, T. (1986). *The view from nowhere*. Oxford: Oxford University Press.
- Pulverer, B. (2015). When things go wrong: Correcting the scientific record. *The EMBO Journal*. doi:10.15252/emboj.201570080.
- QSR International. (2015). NVivo [Computer software]. Melbourne, Australia.
- Rawls, J. (1971). *A theory of justice*. London: Oxford University Press.
- Resnik, D. B., Rasmussen, L. M., & Kissling, G. E. (2015a). An international study of research misconduct policies. *Accountability in Research*. doi:10.1080/08989621.2014.958218.
- Resnik, D. B., Wager, E., & Kissling, G. E. (2015b). Retraction policies of top scientific journals ranked by impact factor. *Journal of the Medical Library Association*. doi:10.3163/1536-5050.103.3.006.
- Toulmin, S., Rieke, R. D., & Janik, A. (1979). *An introduction to reasoning*. New York: Macmillan.
- Vasconcelos, S., Vagird, D., Ichikawa, I., & Plemmons, D. (2014). Authorship guidelines and actual practice: Are they harmonized in different research systems? *Journal of Microbiology and Biology Education*. doi:10.1128/jmbe.v15i2.867.
- Williams, P., & Wager, E. (2011). Exploring why and how journal editors retract articles: Findings from a qualitative study. *Science and Engineering Ethics*. doi:10.1007/s11948-011-9292-0.