Propagation of Error: Impact of Publicizing Serious Problems on Citations to Problematic Research*

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Abstract

Reports of serious errors in academic research are increasingly common. Once the error has been made public, either via a retraction or via publication of research that points to the error, it is often assumed that information about the error has been widely disseminated. And that *approving* citations to the erroneous piece of research will cease. Using a large novel set of retracted articles—over 3,000 retracted articles and over 80,000 citations to retracted articles—and data from a prominent article that highlights a potentially serious concern in a set of articles published in prominent journals, we estimate the change in rate of citations to flawed research due to publicizing the error. We find there is at best a small effect of making errors public on citation counts three years after the error is made public. Our results have implications for design of scholarship discovery systems, and for scientific practice more generally.

*Danielle Portnoy and Xiaoran Huang provided able research assistance. The data and scripts for replicating the analysis can be found at: https://github.com/soodoku/propagation_of_error

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Pressed for time, scientists often default to credulousness when evaluating the research they cite.[1] Science progresses on faith. And it is upended when that faith is misplaced, for instance, when the research being cited contains serious errors.

But how frequent are serious errors? Going by the frequency with which serious errors in manuscripts are publicized, it appears that serious errors are relatively infrequent. For instance, of the nearly 9.4 million articles published between 1950 and 2004 available on PubMed, only 596 have been retracted (Cokol et al. 2007). In all likelihood, however, the true rate of serious errors in manuscripts is manifolds the rate at which the errors are publicized. For instance, Cokol et al. (2007) estimate the rate at which articles ought to be retracted to be anywhere between 16.7 times to 167.8 times the actual rate.

Some may rightly contend, however, that there is no escape from errors in science. Practicing science is committing to a life of trial and error. But it is also true that when errors are made, there are often consequences. For instance, for years research based on observational data was basis for prescribing Hormone Replacement Therapy (HRT) to menopausal women—observational data suggested that HRT lowered the risk of cardiovascular disease. In 2002, however, a Randomized Control Trial came to precisely the opposite conclusion (for the Women's Health Initiative Investigators et al. 2002), leading to a sharp decline in HRT prescriptions (Chlebowski et al. 2009).

More pertinent to our case, however, is the fact that scientific practice assumes a couple of things. It assumes that researchers try in good faith. And that when serious problems in scholarship are made public, 'approving' citations to scholarly works in question stop. Neither is true.

Researchers do not always try in good faith. Partly driven by rewards for publishing, and publishing novel statistically significant results, some slip so far as to fabricate data. Diederik

[1] In fact, it appears that cramped for time at least some scholars do not even carefully read the research they cite, misciting key claims (Sood and Cor 2016).

Stapel, for instance, fabricated data behind at least 30 papers (Levelt, Drenth and Noort 2012), John Darsee behind nearly 100 publications (Stewart and Feder 1987; Anderson et al. 2013; Wallis 1983), and Jan Hendrik Schön, during a period in 2001, published a research paper every 8 days based on fabricated data (Service 2003; Anderson et al. 2013). More notoriously, decline in MMR vaccinations (Alazraki 2011; Haberman 2015; Smith et al. 2008; Gust et al. 2004) can be traced to a paper by Andrew Wakefield linking MMR vaccine to autism using fabricated data (Wakefield et al. 1998; Deer 2011; Godlee, Smith and Marcovitch 2011). And recently Michael Lacour and Donald Green's paper, published in *Science*, was retracted on the evidence that Michael LaCour had fabricated the data (Broockman, Kalla and Aronow 2015; McNutt 2015).[2]

But misconduct is not limited to a few bad actors. A large anonymous survey of early- and mid-career scientists found that about 2% of scientists admitted to engaging in fabricating, falsifying, or plagiarizing in the last *three* years Martinson, Anderson and De Vries (2005) (see also Titus, Wells and Rhoades (2008)). Another study found that nearly 34% of the respondents in past surveys had admitted engaging in questionable research practices Fanelli (2009).

Less frowned upon, though hardly less problematic, variations of bad motivation, including the file-drawer problem—non-significant results never seeing the light of the day (Franco, Malhotra and Simonovits 2014)—and specification searches for producing (nominally) statistically significant results are distressingly common. So are the more fundamental concerns like low power, which reduces the likelihood that a nominally statistically significant finding actually reflects a true effect (Button et al. 2013; Ioannidis 2005). Lastly, ethically problematic issues like plagiarism remain common (Garner 2011).

Not only is the misconduct frequent, even when serious misconduct is made public via retractions, approving citations to problematic research remain common, or so we will show. Citations to erroneous research deserve scrutiny because they can lead to serious problems. One

[2]Other prominent cases include that of William Summerlin, who painted mice rather than transplant skin (Basu 2006; Anderson et al. 2013), Woo Suk Hwang, who claimed to have cloned embryos, Eric Poehlman, who fabricated data behind at least 10 papers and numerous grant applications.

of the key uses of citations is to support a point. And citations to erroneous articles in support of an incorrect point are liable to increase trust in the validity of the point. In the extremum, a reader may become persuaded that the incorrect point is right. And such a reader—generally another academic—may go on to write other articles influenced by the incorrect point, citing the erroneous article for support, or share the point as fact with colleagues and students, propagating the error.

In this paper, we study the impact of publicizing serious errors in research on future citations to problematic research. To study the question, we assemble a large original dataset of retracted articles, and separately, leverage data from an article that highlights a potentially serious problem in article published in prominent venues. Using these two datasets, we first shed light on the scientific retraction process more generally, providing estimates of the time between publication of an article that will eventually be retracted and publication of the retraction notice, frequency of retraction by research area, and reasons why articles are retracted. Next, we estimate the average number of citations problematic articles accumulate before they are retracted. Following that, using an interrupted time series design, we estimate the impact of publication of retraction of an article or publication of an article that highlights serious errors in an article on its citations. We end by discussing what the results tell us about current scientific practice and suggestions for improving the status quo.

Data and Research Design

To investigate whether discovery and publication of serious errors in articles reduces their citations, we assembled two separate sets of data: a large novel dataset of retracted articles, and a database of articles published in prominent scientific journals, like *Science*, containing a potentially serious error.

To create a database of retracted articles, we used Web of Science (WoS) (Reuters 2012).

WoS indexes articles from over 12,000 international journals and 148,000 conference titles (Yong-Hak 2013). WoS includes a variety of key citation indices: *Science Citation Index Expanded* (over 9,500 journals; 1900–present), *Social Sciences Citation Index* (over 3,500 journals; 1900–present), *Arts & Humanities Citation Index* (over 1,700 journals; 1975–present), *Conference Proceedings Citation Index* (over 170,000 conferences; 1990-present), *Book Citation Index* (over 30,000 titles; 2005–present), among others.[3]

We started by creating a list of retraction notices. To do that, we searched WoS for titles containing the phrase "retraction of." This yielded more than 14,000 records. Using the "corrections" filter in WoS, we filtered the list to a final set of 4,085 retraction notices.

Next, we used the list of retraction notices to search the WoS for information about the articles that were retracted. The retraction notice records did not contain consistent titles to facilitate a direct search for the original articles. However, 99% of the retraction notice records contained the year the original article was published, and 96% listed the authors of the original work. We used these two sources of information along with the name of the publication to search for the original articles. This process resulted in an initial list of 3,776 records. (We couldn't locate information about the retracted article for 309 records.)

Due to the imperfect search process, the initial set of 3,776 records contained some false positives—using year of publication, author list, and title of the publication sometimes resulted in multiple results due to authors having multiple publications in the same year in the same publication. Further, in some cases, the authors listed in the retraction notice were editors of the journal instead of authors of the original work. Three sources of information were used to identify and remove the false positives. First, the list of authors of the retracted article was compared to list of authors for the relevant retraction notice record. Records that disagreed were flagged as potential false positives. Second, the title of the retracted article was examined to check

[3]For a full list of titles included in the *Science Citation Index Expanded*, *Social Sciences Citation Index*, *Arts & Humanities Citation Index*, and *Conference Proceedings Citation Index*, and a synopsis of the *Book Citation Index*, see https://github.com/soodoku/propagation_of_error/data/wos/.

if it contained the words "retracted" or "retraction" (it is standard practice for titles of original articles to be revised to indicate the article was retracted). Titles that did not contain either word were flagged as potential false positives. Finally, the titles of the retracted notices were parsed to extract the volume and page number of the original article. Records that did not match on volume and page number were flagged as potential false positives.

The following decision rules were employed to differentiate false and true positives: 1) Records where the authors matched and the title contained the words retracted or retraction were flagged as true positives; 2) records whose authors, volume numbers, and page numbers matched but did not contain the words retraction or retracted in the titles were also taken as true positives; and 3) records that contained the words retraction or retracted in the title and matched on volume and page number but did match on author were taken to be false positives. Remaining potential false positives were examined manually to determine whether the record was a false positive. This process resulted in a final set of 3,359 articles. This served as our final dataset.

Of the final list of 3,359 retracted articles, published between 1974 and 2016, only 3,096 were ever cited. And these 3,096 retracted articles had received a total of 82,238 citations by August, 2016. The retraction notifications of these retracted articles, however, had only been cited a total of 2,435 times by the same time.

Our second dataset comes from articles that mistake difference between significant result and nonsignificant result as significant (Nieuwenhuis, Forstmann and Wagenmakers 2011).[4] In total, Nieuwenhuis, Forstmann and Wagenmakers (2011) analyzed 170 articles published in *Nature*, *Science*, *Neuron*, and *Journal of Neuroscience* between 2009 and 2010 to see if they made that mistake. They found that roughly half of the articles made the mistake. We used WoS to download citations of all the 170 articles, and using data from Nieuwenhuis, Forstmann and Wagenmakers (2011), we analyze how citations to articles with error changed vis-a-vis

We expect retraction or publication of information suggesting potentially serious error

[4]For an explanation of why doing so is erroneous, see Gelman and Stern (2006).

in an article to lead to a decline in citations of the article. We expect the decline in citations to depend on the heftiness of the error, and on how clearly and easily scholars can associate errors with specific journal articles. The heftiest decline should be for articles where the errors were grave enough that they had to be retracted. But the bar for retraction is generally fraud, and not improper statistical methods. Many of the articles simply use improper statistical methods that have crucial implications for the results. For instance, Nieuwenhuis, Forstmann and Wagenmakers (2011) finds that about half of the (relevant set of) articles published in neuroscience mistake difference between a significant result and an insignificant result as evidence for the two being significantly different. On publication of Nieuwenhuis, Forstmann and Wagenmakers (2011), we may expect scientists to become aware of the error in statistical reasoning, and not cite articles that make that particular mistake. But for that to happen, we must assume that scholars read the articles they cite. In fact, evidence suggests otherwise (Sood and Cor 2016). Thus, we expect the effect to be more tepid.

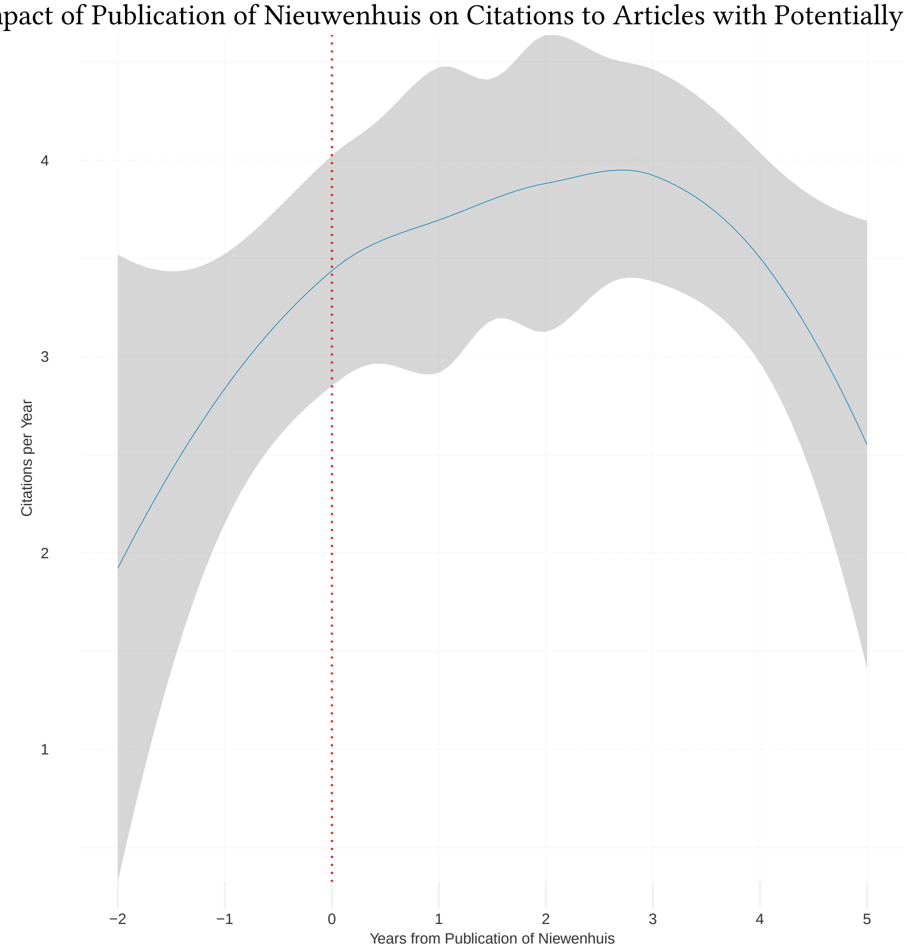
We estimate the impact of publication of error in citations by estimating the change in citation count per month. Given long publication cycles, and assuming the article would have been accepted for publication before the discovery of error, we test the impact of citations two and three years out. In particular, we study these questions using an interrupted time series to measure effects of publicizing of errors on citation rates. In case of Nieuwenhuis, Forstmann and Wagenmakers (2011), we also try a difference-in-difference identification strategy, exploiting the fact that roughly half of similar articles did not have a similar serious error.

Results

We start by describing results from Nieuwenhuis, Forstmann and Wagenmakers (2011) data, and follow it with results from the much larger and more compelling retracted article data.

Figure 1 plots the average number of citations received by each of the paper that was found to contain the potential error per year. As is clear, the average number of citations received by articles remains roughly constant. The mild drop in the fifth year (2016) is an artifact of the fact that our data only extend till August, 2016—only incomplete data is available for 2016. Thus, three years out from publication of Nieuwenhuis, Forstmann and Wagenmakers (2011), there is little or no decline in the rate at which articles in which potentially serious errors were discovered are cited.

Figure 1: Impact of Publication of Nieuwenhuis on Citations to Articles with Potentially Serious Errors



To more formally explore change in citation rate as a consequence of publication of Nieuwenhuis, Forstmann and Wagenmakers (2011), we regress rate of citation per year on a dummy that specifies the year when the article was retracted, linear time trend, and fixed effect for journals. Results show, if anything, a modest uptick in citations after Nieuwenhuis, Forstmann and Wagenmakers (2011) is published (see Table 1).

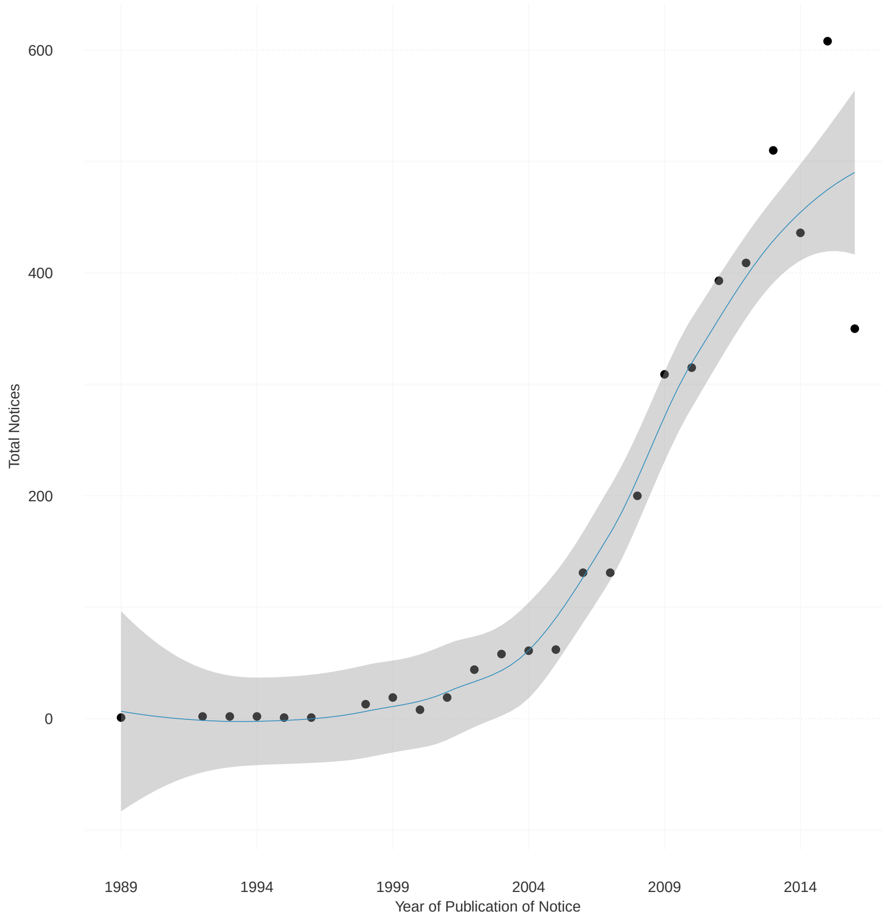
Table 1: Impact of Publication of Niewenhuis on Citations to Articles with Potentially Serious Errors

	Dependent variable:
	Citation Count
Transition Date	2.830***
	(0.567)
Time	−0.244*
	(0.135)
Constant	−1.342
	(6.046)
Observations	2,626
R^2	0.728
Adjusted R^2	0.454
Note:	*p<0.1; **p<0.05; ***p<0.01

Next, we leverage the novel retracted article dataset to shed light on the process of retraction. We start with descriptive data that shed some light on a few important features of scientific retractions—number of retractions over time, why articles are retracted, which research fields tend to have the most retractions, and average time till retraction.

Over the last thirty or so years, the number of retractions have increased sharply (see Figure 2). First retraction notice that we have in our database is from 1989. That year and decade after it, the number of retraction notices being published each year never crossed 20. Since then, there has been a sharp and accelerating increase in retraction notices per year. Between 2001, when 19 retraction notices were published, and 2015, last year for which we have complete data, there was a more than 30 fold increase. There were a total of 608 retraction notices in 2015. The pattern that we find is consistent with results from Steen, Casadevall and Fang (2013), who also find a rapid increase in retractions over time. A good chunk of the increase is likely explained by greater production of research over time, but the particularly sharp increase in the last 15 years suggests that greater editorial awareness and new tools that reduced cost of detection of issues like plagiarism likely played a major role.

Figure 2: Retraction Notices Per Year

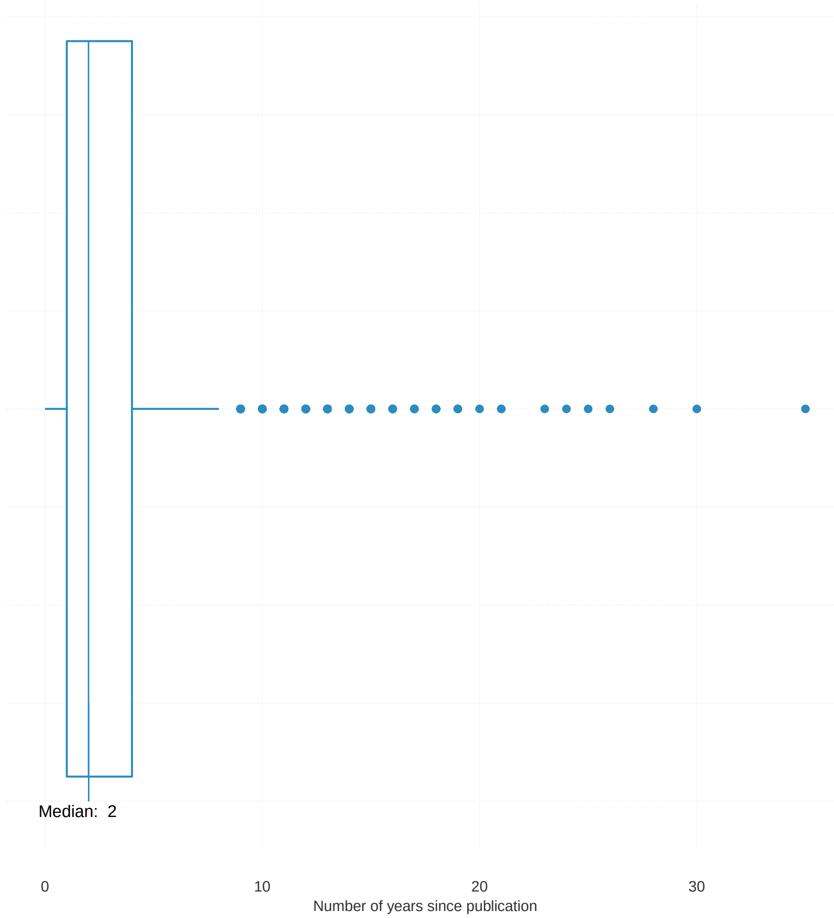


To drill deeper into why articles are retracted, we coded a random set of 115 retraction notices. Of the 115 notices, about 50 articles were retracted due at least in part to plagiarism. (We define plagiarism to include self-plagiarism, duplication of data, words, and publishing the same or similar article in multiple journals.) Major errors or fraud contributed to another 58 retractions, with fraud alone accounting for 27 retractions. Ethics violations (2), conflict over authorship, or approval from other authors (5), copyright (1) contributed to the rest. 50.4% rate of retraction due to fraud that we find is not too similar for some other research on reasons for retraction in other corpora. For instance, a study of 1,112 Biomedicine articles retracted between 1997 and 2009 found that 55% were retracted for some type of misconduct (Budd, Coble and Anderson 2011) (see also Steen (2010)). Plagiarism also continues to be a significant problem. A study of biomedical literature found close to 3,000 publications each year that are "highly similar to citations in previously published manuscripts" (Garner 2011).

Next, we tallied which research areas of the retracted articles. We used advanced search and research area filter in WoS to estimate the number of articles written in English in each of the major research areas that the WoS carried. As of November 1st, 2016, WoS had 363,363 articles in Social Sciences, 287,379 articles in Life Sciences & Biomedicine, 23,532 articles in Physical Sciences, 2,220,516 articles in Technology, and 117,376 articles in Arts & Humanities. And while WoS carries far more Social Science articles than Life Science and Physical Science articles, there were far more retractions in the latter two categories than the former. And perhaps unsurprisingly, there were no arts and humanities retractions. (For a complete list of retractions by research field, see SI 1.)

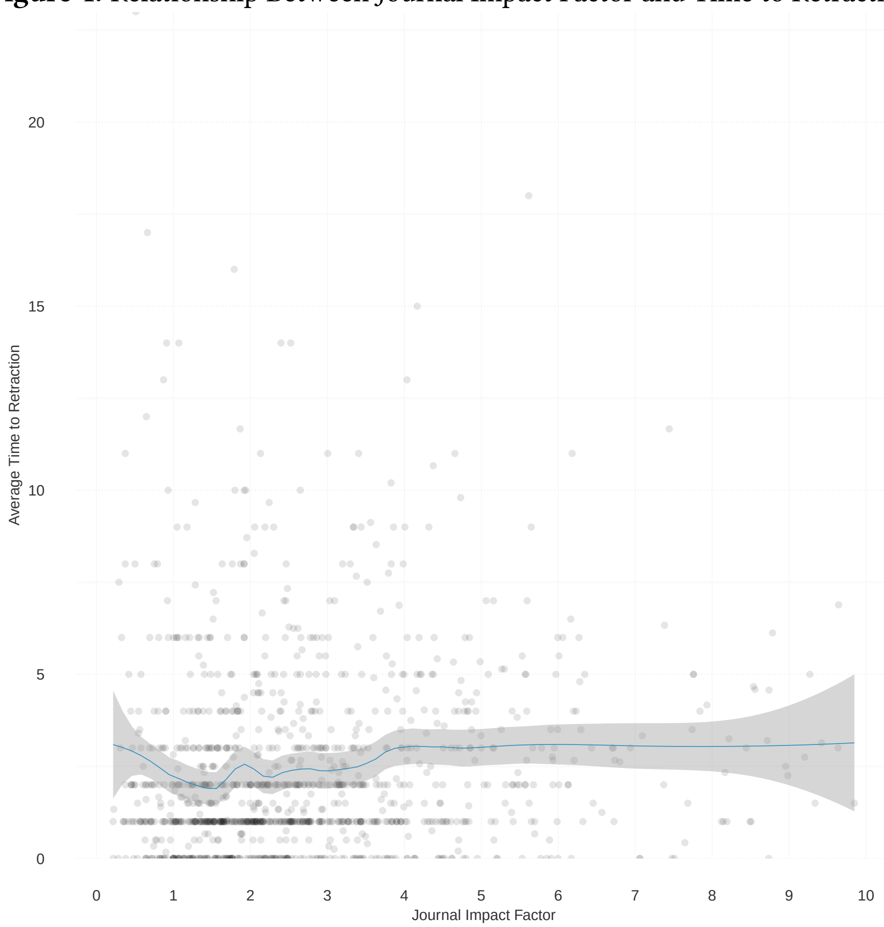
In total, the articles that were retracted were cited 41,347 before they were retracted by November, 2016. On average, it took 2.94 years for the article to be retracted; the median time was 2 years (see Figure 3.) It took more than 25% of the articles 4 or more years. And it took 35 years to retract one article. These numbers compare favorably to a study on time to retraction in the PubMed corpus. Steen, Casadevall and Fang (2013) found that the average time to retraction was nearly 3 years on average, with time to retraction declining over time — from nearly 4 years for articles published in or before 2002 to just over 2 years for articles published after.

Figure 3: Time to Retraction



Next, we estimated the relationship between journal impact factor and average time to retraction on the hunch that prominent journals would attract greater readership, which in turn would more quickly flag problematic research. Surprisingly, there is no relationship between journal impact factor and average time to retraction—flawed articles in low ranked journals are retracted as quickly as flawed articles in higher ranked journals (see figure 4).

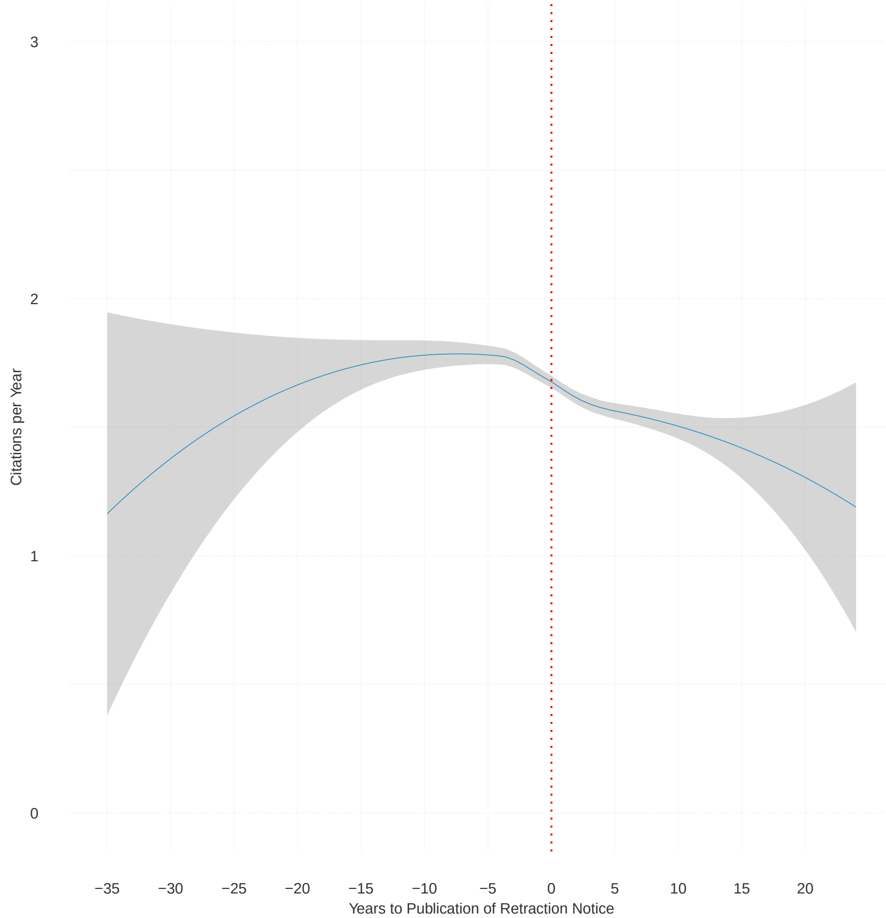
Figure 4: Relationship Between Journal Impact Factor and Time to Retraction



Next, we assessed the impact of publication of retraction on citation. As we note above, retracted articles were cited 41,347 before they were retracted. The retracted articles were cited another 40,872 between the time they were retracted and August, 2016. As we note above, retraction notifications were cited a total of 2,435 times. Assuming citation to retraction notification means not citing the retracted article approvingly, one crude estimate of the total citations that took retracted studies' results to be valid is 38,437. Thus, on average, the 3,268 retracted articles received an additional 11.76 citations after the retraction notice was published and before August, 2016.

To look more carefully at the impact of publication of citation on frequency of citation, we plotted a LOESS over total citations to an article per year. Figure 5 shows a small downturn that coincides with retracted, but followed by a plateauing.

Figure 5: Impact of Publication of Retractions on Citations to Articles



Discussion

Do citations to research with serious errors drop after the errors are publicized? Or does research containing serious errors continue to be cited apace, propagating the error apace? Data suggest that publicizing serious errors via public retractions or publication of research highlighting the problem at prominent venues leads to, at best, a modest decline in citations. Retracted articles continue to be cited approvingly years after they have been publicly retracted.

Our results echo conclusions reached by other research on the topic based on much smaller corpora. Kochan and Budd (1992), for instance, found that John Darsee's papers continued to be approvingly cited even after a considerable time after retraction, and even though the case had generated much publicity. Another study found that although retraction reduces subsequent citation compared with a control group, retracted papers were often cited to support claims (Pfeifer and Snodgrass 1990). Similarly, Budd, Sievert and Schultz (1998) used Medline to identify retracted articles and found that many retracted articles were still being cited as valid.[5]

Citations to flawed research are likely consequential. Such citations very likely affect people's beliefs about the preponderance of evidence on a point. These 'mistakes'—citing flawed research when flaws have been made public—are also avoidable. Assuming that researchers do not knowingly approvingly cite retracted articles, the data imply that discovery of errors even when public retraction notices are issued is still a problem.

To ameliorate the problem, we need to improve access to information about problems in research. One way to improve access to information about problems is to build tools that provide the information as part of existing research discovery and production processes. For instance, altering interfaces of heavily used portals such as Google Scholar, JSTOR, journal publishers' sites etc. so that they thread reproduction attempts, retractions, and other research that directly bears on the evidence presented in an article along with the article are liable to be effective. Rather than effect change in multiple interfaces, which requires coordination with multiple strategic actors, however, a better strategy may be to create a browser plug-in that highlights problematic articles listed on a web page. Providing such a tool to editors or copy editors at academic publishers may also help ameliorate the problem. Flagging problems during the scientific discovery process, however, is clearly better than flagging them during the production process. Flagging during discovery likely preempts the temptation to engage in post hoc rationalization. Alternately, one could build tools that automatically create pull requests to personal bibliography libraries posted

[5]Other research has focused on analyzing the impact of retraction on citations to other work by authors of the retracted research, finding that citations to other research declines when a publication is retracted (Lu et al. 2013; Azoulay, Bonatti and Krieger 2015).

on open publication platforms like GitHub. Lastly, while our study only tallies research that cites known flawed research, it is quite likely that the effect of flawed research extends to studies that cite studies that approvingly cite flawed research (and thereon). And any modifications to the interface should extend to papers that cite flawed research so that people citing them in turn are also warned.

Egregious errors like approving citations to flawed research after the flaws have been made public serve to highlight larger problems with how science is practiced. Scholars do not appear to carefully vet research they cite. In fact, data suggest that scholars do not even always carefully read the research they cite, misciting key claims (Sood and Cor 2016). To improve reliability of scientific production, besides innovating on better tools, we may also need to also penalize research that makes such errors.

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Supporting Information

SI 1 Retraction Notices by Web of Science Field

The fields are decided by Web of Science.

Table SI 1.2: Retraction Notices By Field

Field	Number of Notices	Percentage of Total
BIOCHEMISTRY MOLECULAR BIOLOGY	431	10.44
CELL BIOLOGY	306	7.41
SCIENCE TECHNOLOGY OTHER TOPICS	283	6.86
ENGINEERING	282	6.83
CHEMISTRY	282	6.83
ONCOLOGY	256	6.20
NEUROSCIENCES NEUROLOGY	198	4.80
PHYSICS	188	4.55
PHARMACOLOGY PHARMACY	187	4.53
MATERIALS SCIENCE	179	4.34
ANESTHESIOLOGY	165	4.00
SURGERY	158	3.83
IMMUNOLOGY	155	3.75
RESEARCH EXPERIMENTAL MEDICINE	154	3.73
CARDIOVASCULAR SYSTEM CARDIOLOGY	143	3.46
GENERAL INTERNAL MEDICINE	130	3.15
ENVIRONMENTAL SCIENCES ECOLOGY	114	2.76
PSYCHOLOGY	98	2.37
MECHANICS	90	2.18
HEMATOLOGY	90	2.18
ENDOCRINOLOGY METABOLISM	90	2.18
BIOTECHNOLOGY APPLIED MICROBIOLOGY	87	2.11
BUSINESS ECONOMICS	83	2.01
MATHEMATICS	82	1.99
GENETICS HEREDITY	79	1.91
BIOPHYSICS	64	1.55
RESPIRATORY SYSTEM	63	1.53
MICROBIOLOGY	62	1.50
LIFE SCIENCES BIOMEDICINE OTHER TOPICS	60	1.45
CRYSTALLOGRAPHY	56	1.36
ENERGY FUELS	54	1.31
ACOUSTICS	53	1.28
GASTROENTEROLOGY HEPATOLOGY	51	1.24
COMPUTER SCIENCE	49	1.19
PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	48	1.16
PLANT SCIENCES	46	1.11
PHYSIOLOGY	44	1.07
OBSTETRICS GYNECOLOGY	44	1.07
ORTHOPEDICS	43	1.04
METALLURGY METALLURGICAL ENGINEERING	42	1.02
PATHOLOGY	39	0.94

FOOD SCIENCE TECHNOLOGY	39	0.94
UROLOGY NEPHROLOGY	38	0.92
AGRICULTURE	37	0.90
NUTRITION DIETETICS	36	0.87
INFECTIOUS DISEASES	34	0.82
VIROLOGY	30	0.73
PSYCHIATRY	30	0.73
TOXICOLOGY	29	0.70
DENTISTRY ORAL SURGERY MEDICINE	28	0.68
TRANSPLANTATION	27	0.65
PEDIATRICS	27	0.65
RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	26	0.63
OPHTHALMOLOGY	24	0.58
POLYMER SCIENCE	23	0.56
WATER RESOURCES	21	0.51
REPRODUCTIVE BIOLOGY	20	0.48
OPTICS	20	0.48
GEOLOGY	20	0.48
INSTRUMENTS INSTRUMENTATION	19	0.46
DEVELOPMENTAL BIOLOGY	19	0.46
RHEUMATOLOGY	18	0.44
THERMODYNAMICS	17	0.41
NURSING	16	0.39
LITERATURE	16	0.39
SPORT SCIENCES	14	0.34
OPERATIONS RESEARCH MANAGEMENT SCIENCE	14	0.34
ELECTROCHEMISTRY	14	0.34
EDUCATION EDUCATIONAL RESEARCH	14	0.34
DERMATOLOGY	14	0.34
VETERINARY SCIENCES	13	0.32
PUBLIC ADMINISTRATION	12	0.29
NUCLEAR SCIENCE TECHNOLOGY	12	0.29
METEOROLOGY ATMOSPHERIC SCIENCES	12	0.29
HEALTH CARE SCIENCES SERVICES	12	0.29
ZOOLOGY	11	0.27
REHABILITATION	11	0.27
MEDICAL LABORATORY TECHNOLOGY	11	0.27
EVOLUTIONARY BIOLOGY	11	0.27
EMERGENCY MEDICINE	10	0.24
OTORHINOLARYNGOLOGY	9	0.22
MATHEMATICAL COMPUTATIONAL BIOLOGY	9	0.22
GOVERNMENT LAW	9	0.22
GERIATRICS GERONTOLOGY	9	0.22
SOCIOLOGY	8	0.19
PHYSICAL GEOGRAPHY	8	0.19
INTEGRATIVE COMPLEMENTARY MEDICINE	8	0.19
GEOGRAPHY	8	0.19
BEHAVIORAL SCIENCES	8	0.19
AUTOMATION CONTROL SYSTEMS	8	0.19
ANATOMY MORPHOLOGY	8	0.19
ALLERGY	8	0.19
TELECOMMUNICATIONS	7	0.17
MARINE FRESHWATER BIOLOGY	7	0.17

ASTRONOMY ASTROPHYSICS	7	0.17
ANTHROPOLOGY	7	0.17
SPECTROSCOPY	6	0.14
SOCIAL SCIENCES OTHER TOPICS	6	0.14
INTERNATIONAL RELATIONS	6	0.14
ENTOMOLOGY	6	0.14