Retracted papers clinging on to life:

An observational study of post-retraction citations in psychology

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Abstract

Self-correction is assumed to be a defining feature of science. However, science's ability to correct itself is far from optimal as shown, for instance, by the persistent influence of papers that have been retracted. In this study, we investigated citation patterns for 140 papers retracted in psychology due to data fabrication, scientific misconduct, or error, according to the Retraction Watch Database. After retraction, 88 (63%) of these papers received at least one positive citation (median = 2, interquartile range = 4, min = 0, max = 89 positive citations). These results demonstrate the enduring influence of erroneous or flawed data, even when they have been formally declared as invalid. To ameliorate this problem, we propose several procedures and tools that may enhance the discoverability of retracted papers, including standardization of publisher retraction notices and meta-data, issuance of retraction notices within researchers' reference management software, and automated pre-publication screening for citations to retracted papers.

Keywords: Retractions; Citations; Diederik Stapel; Self-correction.

“A lie can run round the world before the truth has got its boots on.”

Terry Pratchett, *The Truth*.

Although it is undeniable that science makes progress over time, it is unclear if it does so in an optimal way. Questionable research practices and selective publication, coupled with a perverse structure of career incentives, pave the way for the publication of ‘false discoveries’ that can remain unchallenged and influential for long periods of time (Ioannidis, 2012; Nissen et al. 2016). In some cases, the discovery of serious flaws in a published research article prompts a radical measure from the scientific community: retraction of the article from the academic literature. Serious flaws can arise because scientists make innocent mistakes (Aczel et al. 2020; Nath et al. 2006), engage in misconduct, or fabricate data, an ethical breach so severe it is considered by some to be the ninth ‘circle of scientific hell’ (Neuroskeptic, 2012). According to the Committee on Publication Ethics: “Retraction is a mechanism for correcting the literature and alerting readers to publications that contain such seriously flawed or erroneous data that their findings and conclusions cannot be relied upon.” (Wager, Barbour, Yentis, & Kleinert, 2009). Unfortunately, several studies have found that papers continue to be cited years after being retracted, suggesting that current retraction mechanisms are a suboptimal method of scientific self-correction (Bar-Ilan & Halevi, 2017; Budd et al. 1998).

Over the last decade, numerous cases of data fabrication have been discovered in psychological science, leading to the retraction of a significant number of influential articles (e.g., O’Grady, 2020; Servick, 2018; Simonsohn, 2013). With 58 papers retracted due to data fabrication between 2011 and 2019, Diederik Stapel has the most retractions of any psychologist, and the six highest number of retractions overall, according to Retraction Watch (<https://retractionwatch.com/the-retraction-watch-leaderboard/>; Stroebe, Postmes, & Spears,

2012). This massive case of scientific fraud was especially impactful, as it coincided with the seminal publications that triggered the so-called ‘replication crisis’ in psychology and stimulated the adoption of replications and new methodological standards (see Nelson, Simmons, & Simonsohn, 2018). This case also had repercussions beyond the scientific community to the general public (Bhattacharjee, 2013). One may expect that given the enormous impact and extensive media coverage of Stapel’s case, the scientific community must be well aware of the fraud and therefore, his retracted articles should not be cited any longer or, at least, any citing articles should also acknowledge the retraction.

Of course, the mass retraction of Stapel papers is just a prominent example among a growing list of psychology papers retracted because of data fabrication, misconduct, or error. If papers receive positive citations after retraction even in prominent fraud cases, one can only speculate that the problem must be much more serious for the vast majority of retractions, which usually attract little or no attention from the media. What is the fate of these papers? Do researchers stop relying on them, as intended by the editors of the journals who issue the retraction? Or do they continue to exert an influence on the scientific community from the depths of the “retraction underworld”? In the present study, we explored this issue by examining post-retraction citations to all retracted works in the Retraction Watch database classified as ‘psychology’, with an additional focus on retracted papers authored by Stapel.

Methods

Sample

We used the Retraction Watch (RW) database (www.retractiondatabase.org/) to identify retracted articles. This database is considered to be the most comprehensive collection of retractions currently available and contains substantially more retractions than

other databases (I. Oransky, personal communication, February 19, 2021). Retractions are identified for inclusion in the database by continual surveillance, including monitoring journal webpages, institutional reports of misconduct investigations, social media sites, and ‘tips’ from readers of the RW blog. Information is verified against other academic databases (including Scopus, Web of Science, and PubMed) when necessary by RW staff. The subject area (e.g., “psychology”), date of retraction, and reason for retraction are determined by RW staff and therefore, to some extent subjective. Journal publishers employ varied and sometimes suboptimal methods for issuing retraction notices which make it difficult to definitively identify all retractions (Suelzer et al., 2021; Decullier et al., 2013; Steen, 2011); however, we are not aware of any factors (e.g., time of publication, research field, or type of retraction) that might introduce substantial bias into the inclusion process.

A flow chart summarizing each step of the literature search process is available in the Supplementary Material (Figure S1). We searched the Retraction Watch database for all papers classified with the subject ‘psychology’ (search performed November 26, 2019). This search resulted in 538 papers (including conference contributions). After removing two duplicates, 536 papers were retained. Incorrect or missing data (such as missing DOIs or incorrect retraction dates) were corrected or completed when possible. From these papers, we only retained those that were classified as a research article, a review, or a clinical trial, and had been retracted due to data fabrication, scientific misconduct, or error, leaving a total of 152 papers. These inclusion criteria ensured that we only selected retracted papers in which the scientific evidence, and therefore the conclusions of the paper, were completely invalidated by the retraction (e.g., the results of a paper retracted due to its being published in two different journals are not invalidated by the retraction, and therefore any citation to it, although perhaps incorrect, does not undermine the logic of the citing paper). We manually checked the retraction notice of these 152 papers to confirm that they were indeed retracted.

Twelve of them were discarded because their retraction notices were unavailable, behind a paywall, or because they were marked as correct and republished. After this screening, we retained 140 retracted papers.

For all of the 140 retracted papers, we used Scopus to retrieve citing articles that were published at least one year after the retraction date of the corresponding retracted paper ($N = 762$) in order to allow for publication lag (papers already in the publication pipeline when the retraction occurred) and time for databases to index retraction notices (Budd et al., 1998). From those, we removed 111 citations for the reasons summarized in Table 1, leaving a total of 651 post-retraction citations for the main analysis.

Table 1. Reasons for exclusion of citations to retracted papers

N discarded	Reason
54	No DOI was provided.
27	Unreachable: No longer available / Wrong URL / Behind a paywall.
14	Language was not English.
8	Retracted paper was not cited.
7	Citation appeared in the references but not in the text.
1	Not an article.

Procedure

We categorized each individual post-retraction citation as positive, negative, or neutral. We considered a citation to be positive if it mentioned the results of the retracted paper as a valid source of knowledge¹, neutral when there was no reference to the results of the paper (e.g., referring only to the methodology), and negative when the retraction was

¹ Note that in our coding scheme, a citation can be considered positive even if it criticizes the original study for reasons unrelated to its retracted status (e.g., issues with validity, non-replication).

explicitly acknowledged. The first and last authors independently coded whether citations were positive, negative, or neutral based on the fragment of the text where the citation took place. Disagreements were discussed until resolved.

For 449 post-retraction citations published in journals indexed in the Journal Citation Reports (JCR), we also recorded the subject areas of the journal where each was published, as well as the impact factor quartile of the journal in the year of publication. If the impact factor was not available yet for that year, we used the last one available at JCR. We classified papers as *Psychology* if any of the subject-area terms contained the term “Psychology” and as *Others* if they did not. If the paper was classified as *Psychology*, we reported the impact factor quartile of the psychology area. Otherwise, we reported the lowest impact factor quartile of the subject areas reported by JCR for that article.

Results

Figure 1 shows the evolution of citations to retracted psychology articles over time. The difference between pre- and post-retraction periods shows that citation counts declined following retraction, but collectively they still received an important number of citations, most of them positive. A closer exploration reveals that the distribution of positive post-retraction citations across retracted papers is highly skewed. After retraction, 52 (37%) of the 140 papers did not receive a single positive citation, while 88 (63%) of them received at least one and two of them received more than 50. Overall the median number of positive post-retraction citations was 2 (interquartile range = 4, min = 0, max = 89 positive citations). Figure 2 shows the evolution of positive citations to each individual retracted paper. As can be seen, two retracted papers (Walumba et al., 2010, 2011) were responsible for the vast majority of positive citations, with the rest of papers only occasionally achieving more than 4-5 citations.

Figure 1. Citation counts relative to the year of article retraction.

Figure 2. Number of positive citations to each retracted paper relative to the year of article retraction.

Each retracted paper is denoted by a different color.

From the 651 post-retraction citations included in the present study, 591 were positive (90.8%). Table 2 summarizes the number of positive, negative, and neutral citations, separately for the 449 articles that were published in JCR-indexed journals and for the 202 articles not indexed in the JCR. Approximately 91.5% of the citations from JCR-indexed journals were positive citations and 45.4% occurred in first-quartile impact factor journals. 129 citations came from a psychology journal. Among them, 36 (27.9%) were positive

citations from first-quartile impact factor journals. The proportion of positive citations is similar for journals not indexed in the JCR.

Table 2. Number (%) of post-retraction citations by impact factor quartile (Q) and type of citation

Citation type	Q1	Q2	Q3	Q4	Total
All JCR					
Positive	179 (39.9%)	102 (22.7%)	95 (21.2%)	35 (7.8%)	411 (91.5%)
Neutral	6 (1.3%)	3 (0.7%)	1 (0.2%)	1 (0.2%)	11 (2.4%)
Negative	19 (4.2%)	2 (0.4%)	6 (1.3%)	0 (0.0%)	27 (6.0%)
<i>Total</i>	<i>204 (45.4%)</i>	<i>107 (23.8%)</i>	<i>102 (22.7%)</i>	<i>36 (8.0%)</i>	<i>449 (100.0%)</i>
Psychology					
Positive	36 (27.9%)	43 (33.3%)	21 (16.3%)	6 (4.7%)	106 (82.2%)
Neutral	4 (3.1%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	7 (0.8%)
Negative	10 (7.8%)	1 (0.8%)	5 (3.9%)	0 (0.0%)	16 (12.4%)
<i>Total</i>	<i>50 (38.8%)</i>	<i>45 (34.9%)</i>	<i>27 (20.9%)</i>	<i>7 (5.4%)</i>	<i>129 (100.0%)</i>
Psychology					
Positive	136 (42.2%)	64 (20.0%)	74 (23.1%)	31 (9.7%)	305 (95.3%)
Neutral	2 (0.6%)	2 (0.6%)	0 (0.0%)	0 (0.0%)	4 (1.2%)
Negative	9 (2.8%)	1 (0.3%)	1 (0.3%)	0 (0.0%)	11 (3.4%)
<i>Total</i>	<i>147 (45.9%)</i>	<i>67 (20.9%)</i>	<i>75 (23.4%)</i>	<i>31 (9.7%)</i>	<i>320 (100.0%)</i>
Non-JCR					
Positive	180 (89.1%)				
Neutral	5 (2.5%)				
Negative	17 (8.4%)				
<i>Total</i>	<i>202 (100.0%)</i>				

Figure 3 and Table 3 show the same information for the subset of retracted papers authored by Diederik Stapel. As can be seen, despite the extensive media coverage received

by this case of fraud, Stapel's papers still receive a substantial number of citations many years after their formal retraction, most of them positive.

Figure 3. Citation counts relative to the year of article retraction, only for the subset of 53 articles authored by Stapel. Note that the substantial decline in the number of citations for year 8 is an artifact due to the fact that almost all articles by Stapel included here were retracted in 2011 and data for this study were gathered in 2019.

Table 3. Number (%) of post-retraction citations by impact factor quartile (Q) and type of citation for retracted articles authored by Stapel

Citation type	Q1	Q2	Q3	Q4	Total
All JCR					
Positive	41 (37.3%)	29 (26.4%)	22 (20.0%)	5 (4.5%)	97 (88.2%)
Neutral	5 (4.5%)	1 (0.9%)	0 (0.0%)	0 (0.0%)	6 (5.5%)
Negative	6 (5.5%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	7 (6.4%)
<i>Total</i>	<i>52 (47.3%)</i>	<i>30 (27.3%)</i>	<i>23 (20.9%)</i>	<i>5 (4.5%)</i>	<i>110 (100.0%)</i>
Psychology					
Positive	11 (26.8%)	15 (36.6%)	7 (17.1%)	0 (0.0%)	33 (80.5%)
Neutral	4 (9.8%)	1 (2.4%)	0 (0.0%)	0 (0.0%)	5 (12.2%)
Negative	2 (4.9%)	0 (0.0%)	1 (2.4%)	0 (0.0%)	3 (7.3%)
<i>Total</i>	<i>17 (41.5%)</i>	<i>16 (39.0%)</i>	<i>8 (19.5%)</i>	<i>0 (0.0%)</i>	<i>41 (100.0%)</i>
Psychology					

Positive	27 (39.1%)	15 (21.7%)	17 (24.6%)	5 (7.2%)	64 (92.8%)
Neutral	1 (1.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.4%)
Negative	4 (5.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (5.8%)
<i>Total</i>	<i>32 (46.4%)</i>	<i>15 (21.7%)</i>	<i>17 (24.6%)</i>	<i>5 (7.2%)</i>	<i>69 (100.0%)</i>

Non-JCR					
Positive	27 (90.0%)				
Neutral	2 (6.7%)				
Negative	1 (3.3%)				
<i>Total</i>	<i>30 (100.0%)</i>				

Discussion

Our results show that psychology papers can continue to receive positive citations for years after being retracted due to data fabrication, scientific misconduct, or error. This pattern is also present in high-impact factor journals, citing articles published in non-psychology research fields, and for papers implicated in the infamous fraud case of Diederik Stapel (Bhattacharjee, 2013; Nelson et al. 2018; Strobe et al. 2012). Our findings are consistent with prior studies that have documented ongoing positive citation of retracted articles published in biomedicine and other domains (Bar-Ilan & Halevi, 2017; Bucci, 2019; Candal-Pedreira et al., 2020; Pfeifer & Snodgrass, 1990). Together, these findings demonstrate the enduring influence of invalidated academic articles and highlight the inadequacy of existing retraction procedures. On the positive side, most articles only received a few post-retraction positive citations. Only a small number of papers received a concerning number of positive citations. Two of them in particular (Walumba et al., 2010, 2011) have gathered 89 and 60 positive citations in the 5-year period from their formal retraction in 2014 to the date when data were collected for the present study. Both of them remain highly influential at the time of writing.

Most likely, the vast majority of positive post-retraction citations are innocent errors, caused by a lack of awareness of the retracted status of the cited paper.² Fortunately, with current technology, it should be relatively straightforward to detect and prevent inadvertent citation of retracted articles. Firstly, human-readable retraction notices should be prominently affixed to retracted articles on publisher websites. Secondly, articles should be promptly tagged with standardized machine-readable meta-data, signaling to relevant secondary sources (e.g., academic databases like PubMed) that the article has been retracted. Secondary sources should continually monitor articles' retraction status and ensure that this information is conveyed to users. Several studies have highlighted that existing procedures for displaying retraction notices and issuing meta-data are inconsistent and suboptimal (Suelzer et al., 2021; Decullier et al., 2013; Steen, 2011).

Improved standardization and dissemination of retraction status should help to increase awareness of retractions when researchers obtain articles from publisher websites and academic databases. However, researchers also use versions of articles that are beyond publishers' control and are therefore more difficult to update with retraction notices; for example, articles stored on preprint servers, institutional repositories, or personal websites (Davis, 2012). Additionally, after downloading or printing articles, researchers may never consult the original source again. In some cases, researchers cite articles they have not even read (Ioannidis, 2018).

Several additional tools can help to ensure that researchers are made aware of article retractions, even if they do not consult or revisit the original source. Firstly, the creation of

² Nevertheless, it is difficult to understand how some authors could have been unaware of the fact that they were citing a retracted paper. For instance, we observed that some papers cited the title of the retracted version of the paper, which explicitly includes the word "retracted". This means that at some stage during the writing or publication process the retracted status of the article was known. Of all positive post-retraction citations, 8.5% referenced the retracted version of the retracted paper, 5.4% when considering only citations from first quartile journals.

dedicated databases of retracted articles (e.g., Crossmark, openretractions.com, retractionwatch.com)³, ideally under public control and openly available, may help to support other tools that are capable of alerting researchers to changes in retraction status (Bucci, 2019). By relying on such a database, researchers' personal reference management software can automatically check articles' retraction status and issue retraction notifications and citation warnings. The reference manager *Zotero* already provides this functionality based on retractions listed in the Retraction Watch database (<https://www.zotero.org/blog/retracted-item-notifications/>). Publishers could use similar citation tools that check retraction status when documents are prepared for publication. Another useful tool can scan draft manuscripts and check the retraction status of any cited article. The R package *retractcheck* extracts DOIs from articles and checks their retraction status in the Open Retractions database. This kind of automated check could be effortlessly embedded into the publication pipeline (Cosentino & Veríssimo, 2016; Weissgerber et al., 2021) as is currently done to screen for plagiarism with tools like Turnitin or flag statistical reporting inconsistencies with tools like *statcheck* (Nuijten, Hartgerink, van Assen, Epskamp, & Wicherts, 2016).

The present study has some limitations. Firstly, it is unlikely that we have obtained all articles retracted in psychology. We relied upon the Retraction Watch database because it is considered to be the most comprehensive collection of retracted articles available. However, publishers' inconsistent methods for identifying retracted articles mean that any database of this kind will be necessarily incomplete. Additionally, the assignment of retracted articles to the subject category "psychology" was performed by Retraction Watch staff and was therefore, inherently subjective and contestable. Secondly, retraction is arguably the most obvious situation that necessitates scientific self-correction because results have been

³ Unfortunately, at present, all of these databases are incomplete due to suboptimal use of retraction meta-data by publishers.

formally declared invalid. Other situations requiring self-correction are more nuanced and complicated; nevertheless, there is some evidence of enduring positive citations after studies have been convincingly contradicted by subsequent replication results (Hardwicke et al., 2021) or studies with superior designs (Tatsioni et al., 2007). Finally, our study only focused on post-retraction citation patterns and therefore did not gauge other potentially relevant indicators of researchers' belief in the original findings, such as social media activity (Serghiou et al., 2021).

In sum, the present study shows that retracted psychology papers can still receive positive citations many years after their formal retraction. These citations do not come only from marginal journals or publications unrelated to psychology; retracted articles are often cited in some of the highest ranked psychology journals. The case of Stapel illustrates that the continued influence of retracted research can occur even after extensive media coverage. Fortunately, the tools needed to remedy this problem already exist. Long gone are the days in which retraction alerts had to be issued by librarians in the form of stamps on printed journals, or monthly lists of retracted papers (Cooper, 1992). With electronic journals, databases, digital object identifiers, reference management software, and other modern tools and infrastructure, retracted papers should *die easily*.

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Open practices statement

This study was not preregistered. As we have obtained the full population of interest, no sample size determination was performed. All manipulations, exclusions and measures are reported in this manuscript, with the only exception that earlier versions of the data set included references to retracted papers by Wansink and Smeesters that did not appear in the original search in RetractionWatch. All data, materials, and analysis scripts needed to replicate this study and reproduce the results are available at <https://osf.io/cwp93/>.

Conflict of interest statement

All authors declare no conflict of interest.

Author contributions

MAV and LMF developed the study concept. LMF retrieved the data and performed the analysis. All authors drafted the manuscript, reviewed the manuscript and approved the final version of the manuscript for submission.

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