The Dissemination of Scientific Fake News

On the Ranking of Retracted Articles in Google

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Emmanuel Genot and Erik J. Olsson

Abstract: Fake news can originate from an ordinary person carelessly posting what turns out to be false information or from the intentional actions of fake news factory workers, but broadly speaking it can also originate from scientific fraud. In the latter case, the article can be retracted upon discovery of the fraud. A case study shows, however, that such fake science can be visible in Google even after the article was retracted, in fact more visible than the retraction notice. We hypothesize that the reason for this lies in the popularity-based logic governing Google, in particular its foundational PageRank algorithm, in conjunction with a psychological law which we refer to as the "law of retraction": a retraction notice is typically taken to be less interesting and therefore less popular with internet users than the original content retracted. We conduct an empirical study drawing on records of articles retracted due to fraud (fabrication of data) in the Retraction Watch public database. The study tests the extent to which such retracted scientific articles are still highly ranked in Google – and more so than information about the retraction. We find, among other things, that both Google Search and Google Scholar more often than not ranked a link to the original article higher than a link indicating that the article has been retracted. Surprisingly, Google Scholar did not perform better in this regard than Google Search. We also found cases in which Google did not track the retraction of an article on the first result page at all. We conclude that both Google Search and Google Scholar run the risk of disseminating fake science through their ranking algorithms.

1. Introduction

Fake news can originate from an ordinary person carelessly posting what turns out to be false information (Maheshwari, 2016) or from the intentional actions of fake news factory workers (Sydell, 2016), but it can also originate from scientific fraud. Broadly speaking, a published scientific article based on fraud qualifies as "scientific fake news", although we will prefer the term "fake science" – what looks like science but in fact is not – in an effort to avoid contentious issues regarding the exact definition of "fake news" (cf. McIntyre, 2018). In 2016, a Swedish research group published an article in the journal *Science* claiming that fish eat plastic and that this has dire consequences for the eco-system (Lönnstedt and Eklöv, 2016). This was picked up by many news organizations, including the *BBC*, which covered the study in an article (McGrath, 2016), including the fact that it was published in the prestigious journal *Science*. A normal reader of the *BBC* article would be likely to conclude that the Swedish study is true. However, about a year later, *Science* retracted the article on grounds of scientific fraud. In spite of this, one of us found that weeks after the retraction, Google continued to rank *BBC*'s coverage of the article higher than content, including *Science*'s own notice, informing about the retraction when searching on "Fish eat plastic".

Indeed, more than one year later, in January of 2018, search in Swedish Google returned only articles from environmentalist websites covering the original study on the first search result page, often with endorsement ("the study shows that …") and without information about the retraction. This was

after, in addition to *Science*, two independent committees and, finally, the Vice Chancellor of the university in question had declared the study fraudulent (Koffmar, 2017) – just to exclude the potential objection that the Swedish study is solid after all, and Google knows this and the scientific community doesn't.

One of us re-did the same search a few months later (mid-2018) with similar results. Search on "fish eat plastic" returned the original *BBC* article on the first Google result page with the most highly ranked information about the retraction, in an article in *Fortune* (Morris, 2017), being found on the second result page. The same was true for Google Scholar. According to Google, then, the original and now seriously misleading *BBC* article was still more "important" or "relevant" than the true and non-misleading article about the retraction. This is simply the wrong result. For a user interested in the topic of the article it would be more important or relevant to learn that it has been retracted than to be presented with a coverage of the original, fraudulent article.

How common is this phenomenon and how deeply does it affect Google? In this paper, we conduct a pilot study testing one aspect of the, as it turns out, complex issue of retraction due to scientific fraud in Google, namely, the extent to which Google ranks original content higher than the notice of the retraction, drawing on a sample of articles retracted due to fabrication of data in the Retraction Watch public database (https://retractionwatch.com/). As a preliminary, we introduce, in section 2, the problem of retraction in search engines and conjecture that it might be a "deep" problem given (a) underlying algorithms that prioritize popularity and (b) a hypothesized tendency in humans to think that information about retraction is less interesting, and therefore less popular, than the content of the original article. In section 3, we formulate three testable hypotheses regarding the relative ranking of links to original articles and links indicating their retraction. Our results are provided in section 4 and discussed in section 5, where we also propose a number of ways to extend our work.

2. Background: why retracted articles may be deep problem for Google

Why might the tech giant Google, with its huge resources, be struggling with the rather fundamental problem of correctly ranking retractions? One aspect is of course that Google Search does not have any deeper insight into the actual content of webpages. The algorithm behind it does not understand, at a deeper level, that *BBC*'s article is about a scientific article that was later declared fraudulent, failing to semantically connect the one to the other.

A second aspect is that Google, at its core, bases its ranking on popularity with users and web administrators. This is captured not only in the number of clicks but also, characteristically, by Google's foundational PageRank algorithm, according to which, roughly, more popular content is ranked higher than less popular content.[1] PageRank implements this idea at the level of links (sometimes called "hyperlinks"), so that webpages that receive many incoming links from other webpages are more highly ranked. Moreover, a link from a webpage that itself has many incoming links has more weight than a link coming from any old webpage. By these criteria, *BBC*'s website will receive a very high ranking in Google: many link to it and many of the links come from other often-linked-to websites, such as other media outlets. Based on these considerations, one would expect an article in the *BBC*, such as the fish report alluded to in the introduction, to be practically "glued" to the first result page in Google, even after the material it is about was retracted.

However, matters are in fact much more complex. As the Google founders noticed in their seminal technical report, the ability of PageRank to track "importance" or "relevance" online depends on web administrators in a sense knowing what they are doing; they have to be capable of distinguishing relevant from irrelevant content and decide to include links to other webpages on the basis of that capacity. Recent studies have confirmed that PageRank tracks desirable properties of webpages, such as importance or relevance, under some rather austere conditions (Masterton, Olsson and Angere, 2016, Masterton and Olsson, 2018a). The less austere conditions identified in Masterton and Olsson (2018b) have so far been shown to be realistic only in a minimal sense.

It is not surprising, then, that since PageRank was introduced Google has added some reportedly 300+ "quality signals" to fine-tune its search results. These other signals are subject to change and their precise nature is a trade secret not revealed by Google. However, advice on the Google homepage for how to write highly ranked content[2] suggests that many signals are there for detecting misspellings, grammatical failures, and other signs of low quality at the textual level. Still other signals are used for detecting the position of the search term within the text, so that a text in which the search term figures early on in the article is considered more relevant and ranked higher *ceteris paribus*.

Now, in the case of the information in *Forbes* about the retraction of the fish study, we may assume there are no essential differences between that article and the *BBC* coverage. Both were well-written, the search term "fish eat plastic" figures in prominent places, and so on. Hence, it is plausible to account for the higher ranking of the *BBC* coverage in relation to the *Forbes* retraction in

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[1] For this aspect of Google, see Surowiecki (2004), p. 16, and Thelwall (2013), p. 77.
[2] See https://support.google.com/webmasters/answer/7451184?hl=en

terms of the former being more often linked to and generally more popular than the latter. People are simply more interested in reading and sharing an article on how fish eat plastic than in reading and sharing a follow-up on the retraction of that same article.

The reality here is that Google and other search engines that promote popular content may have hit the wall in the form of a proposed law of human psychology, which we might call the *Law of Retraction*: retractions are generally less interesting and therefore less popular with users and webpage administrators than the original information retracted. There are certainly exceptions to this rule. In a highly polarized debate, for instance, the retraction may play into the hands of the other camp. If the latter has sufficient representation in the population, this may make the retraction popular. In a less polarized debate, or a debate in which the camp benefitting from a retraction is weak, we would expect the proposed law to hold. If this is true, Google and other search engines based on similar algorithms may have a fundamental problem that hinders them from effectively preventing fake science from being disseminated.

3. Methodology

The general principle we believe should be respected by search engines is the following:

Criterion A: True and non-misleading information about X should be ranked higher than false or seriously misleading information about X, *ceteris paribus*.

Based on our reasoning so far, we would expect Google to violate Criterion A by violating the following, more specific principle:

Criterion A*: A true and non-misleading report to the effect that a particular scientific article has been retracted should be ranked higher than the retracted article itself or a now false or seriously misleading coverage of the latter, *ceteris paribus*.

We cannot test directly whether Google satisfies Criterion A* or not, as it stands. For one thing, what should be the criterion for "satisfaction" here? What is the precise criterion for being a report to the effect that a given article has been retracted? For a report being "true" or "false"? What search terms should be used?

In operationalizing some of these issues, we rely on the *Retraction Watch* public database of retracted articles (https://retractionwatch.com/). *Retraction Watch* is considered to be a respectable source on retractions and is reportedly collaborating with the prestigious *Science* journal on retractions (Brainard and You, 2018). We assume, therefore, that the information in the database is

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correct regarding what has been retracted, when the retraction took place and for what reason. Furthermore, our study was restricted to retracted articles satisfying the following criteria:

B1. The article reported original research in a peer-reviewed scientific journal according to the standard editorial procedure for that journal.

B2. The article has identifiable date for both its initial publication and its retraction notice.

B3. The article has been retracted for reasons that amount to fraud (fabrication of data).

Criterion B1 excludes invited publications fall out of the regular peer-reviewing process (invited contributions that summarize earlier work, editorial mistakes) as well as serious, but non-peer reviewed, publications, such as articles published by the original author of a peer-reviewed article in a non-peer reviewed journal (such as *Scientific American*).

Criterion B2 excludes articles for which either the date of the original publication or the date of the retraction is not identifiable. For instance, according to the *Retraction Watch* website, some publishers merely overwrite the original article's HTML page with the retraction notice. In such cases, the entry will have matching dates for both the original article and for the retraction notice, making the dates of publication and retraction impossible to separate. Criterion B2 also excludes notices that are weaker than retraction, such as corrections and expressions of concern, which do not always result in later retractions. Criterion B3 excludes retractions that occur for reasons other than fraud, i.e. honest mistakes in data handling or issues with reproducibility.

In order to keep the sample manageable for a pilot study, we restricted our search to all articles retracted between October and December 2018. Our reasoning for not including articles that were retracted later was that a shorter time span between retraction and the time of our study (November 2019) might not leave sufficient time for search algorithms to learn that the article had been retracted and adjust the search results accordingly.

When considering articles for inclusion, we first controlled for compliance with Criterion B3 and selected articles retracted for fabrication of data, which is a clear-cut case of academic fraud.[3] The principles for sample selection yielded 24 articles, all of them having distinct dates for publication and retraction, thereby complying with Criterion B2. All selected articles had initially appeared in journal published by reputable, non-predatory scientific publishers (*Elsevier*, *Springer*, *Wiley*, among

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[3] Thus, in effect, invoking B3 means that we operationalize "false" in Criterion A* as "retracted due to fabrication of data". It is certainly possible that a study based on fabrication of data still reaches conclusions that happen to be true, but we conjectured that such cases would, in practice, be very few. For the point that retraction and fraud are not the same, see McIntyre (2019).

others) thereby satisfying Criterion B1. The result was, as we will see, quite striking and we do not expect that including more articles would substantially change our results and conclusions.

Searches were by (complete) title in both Google Search and Google Scholar at two locations (to avoid effects of IP geolocation): the university to which the authors are affiliated, and the private home of the author carrying out the empirical study. All searches were carried out in the period November 18-19, 2019. In the following, we refer to search on complete titles as "title search". Searches were done on distinct computers (to avoid identification through MAC addresses) and via anonymous browsing in Chrome. The first Google result page for each query was saved. Studies have shown that users rarely go beyond the first result page (Genot and Olsson, 2017).

By a "retraction link" we mean in the following a link of the form "Retracted: [Title]", where the title is that of the article that has been retracted or a similar link beginning with "retracted" or "retraction notice". By an (original) "article link" we mean a link of the form "[Title]" where the title is that of the retracted article. We interpreted Criterion A* as stating that a retraction link should be ranked higher than the corresponding article link.

Based on the consideration and methodological choices above, we devised two main hypotheses to be tested:

Hypothesis 1 (H1): Google Search violates Criterion A* *more* often than not.

Hypothesis 2 (H2): Google Scholar violates Criterion A* *less* often than not.

As for H2, we conjectured that, given that Google Scholar is tailored specifically for ranking scientific works, there should be relatively few violations of Criterion A*. In other words, we expected there to be comparatively few cases in which an article link would be more highly ranked than a retraction link. In particular, there would be fewer violations against Criterion A in Google Scholar than in Google Search:

Hypothesis 3 (H3): Google Search generally violates Criterion A* more often than Google Scholar does.

In our Google Scholar study, we also investigated what this resource regarded as the "best result" to a title query – an article link or a retraction link. For the same reasons that we conjectured that H2 and H3 would be true, we also expected retraction links to be considered "best results" by Google Scholar.

4. Results

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In our study, we found that Google Search almost always ranked article links higher than the corresponding retraction link. This was so regardless of whether the searches were made from the university (22/24) or from the home of the author carrying out the study (21/24). In the cases in which the article link was ranked higher than the retraction link, the retraction links were more often than not ranked second to the retracted article. However, multiple instances of article links were often listed first (Figure 1). In some cases, finding a retraction link required the manual operation of scrolling down the page on a small laptop screen in addition of running the search. Thus, the results from our test was completely consistent with our hypothesis that Google Search would violate Criterion A* more often than not (H1).

Figure 1: Example of how multiple article links are often ranked higher than retraction links in Google Search.

However, H2 and H3 were *disconfirmed* by our study in both the university and home searches. Google Scholar, too, violated criterion A* more often than not. In fact, its performance was no better than that of Google Search in this regard. Furthermore, In 21/24 cases at both the university and at home, Google Scholar first proposed a shortlist of "best result" which, in 12/21 cases failed to list a retraction link but instead often showed just an article link (Figure 2).

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Infusion of amino acid enriched solution hastens recovery from neuromuscular block caused by vecuronium
Y Saitoh, K Kaneda, Y Tokunaga... - British journal of ..., 2001 - academic.oup.com
We investigated the effect of an amino acid infusion on neuromuscular block produced by
vecuronium, and on rectal temperature and surface temperature over the adductor pollicis
muscle. Sixty adult patients undergoing general anaesthesia were randomly divided into
four groups of 15 patients each: amino acid (AA)-post-tetanic count (PTC); AA-train-of-four
(TOF); control (C)-PTC; or C-TOF group. In the AA-PTC and AA-TOF groups, after a bolus
of vecuronium 0.1 mg kg–1, a continuous infusion of an 18 amino acid enriched solution ...
☆ 𝟁𝟁   Cited by 15   Related articles   All 11 versions

Showing the best result for this search. See all results

Figure 2: Example of an article link being proposed as "best result" for a title search in Google Scholar even though the article has been retracted.

The retraction link appeared in extended search results upon selected the option "show all results" in no more than half of those cases, and the retraction link was then often further down on the result page (Figure 3).

Infusion of amino acid enriched solution hastens recovery from **neuromuscular block caused** by **vecuronium**
Y Saitoh, K Kaneda, Y Tokunaga... - British journal of ..., 2001 - academic.oup.com
We investigated the effect of an amino acid infusion on neuromuscular block produced by
vecuronium, and on rectal temperature and surface temperature over the adductor pollicis
muscle. Sixty adult patients undergoing general anaesthesia were randomly divided into ...
☆ 𝟁𝟁   Cited by 15   Related articles   All 11 versions

Role of **amino acid infusion** in delayed **recovery** from **neuromuscular blockers**
S Kalra, R Wadhwa - Indian journal of anaesthesia, 2010 - ncbi.nlm.nih.gov
... heat production by administration of **amino acid infusion**[9]. **Amino acids infused** during general ...
prevent postoperative hypothermia[9]. Previous studies have found that IV **amino acid infusions**
exert enhanced ... 7. Saitoh Y, Kaneda K, Tokunaga Y, Murakawa M. **Infusion** of **amino** ...
☆ 𝟁𝟁   Cited by 6   Related articles   All 7 versions

Drugs to facilitate **recovery** of **neuromuscular blockade** and muscle strength
Y Saitoh - Journal of anesthesia, 2005 - Springer
... Selldén E, Brundin T, Wahren J (1994) Augmented thermic effect of **amino acids** under general
anaesthesia: a mechanism useful for ... 2. After intravenous **infusion** ... RA, LeJemtel TH, Likoff MJ
(1987) Efficacy and safety of sustained (48 hour) intravenous **infusions** of milrinone in ...
☆ 𝟁𝟁   Cited by 9   Related articles   All 8 versions

A Prospective Randomized Double Blind Study to Evaluate the Effect of **Infusion** of **Amino Acid Enriched Solution** on **Recovery** from **Neuromuscular Blockade**
N Gupta, R Sehgal, R Kumar, KR Sharma... - Indian journal of ..., 2009 - ncbi.nlm.nih.gov
... Results. The four groups were similar in their demographic profile, type and duration of surgery,
ambient temperature and amount of fluids **infused** (Table 1) (p>0.05 ... Satioh Y, Kaneda K, ToKunaga
Y, Murakawa M. **Infusion** of **amino acid enriched solution hastens** the **recovery** ...
☆ 𝟁𝟁   Cited by 5   Related articles   All 10 versions

Retraction notice to "**Infusion** of **amino acid enriched solution hastens recovery** from **neuromuscular block caused** by **vecuronium**"[Br J Anaesth 2001; 86: 814–821]
Y Saitoh, K Kaneda, Y Tokunaga... - British journal of ..., 2019 - Elsevier
Statistical analysis suggests that the data may be fabricated. Y Saitoh provided a statement
in a personal communication to a member of the editorial board of British Journal of
Anaesthesia that the study was not approved by the Institutional Review Board and that no ...
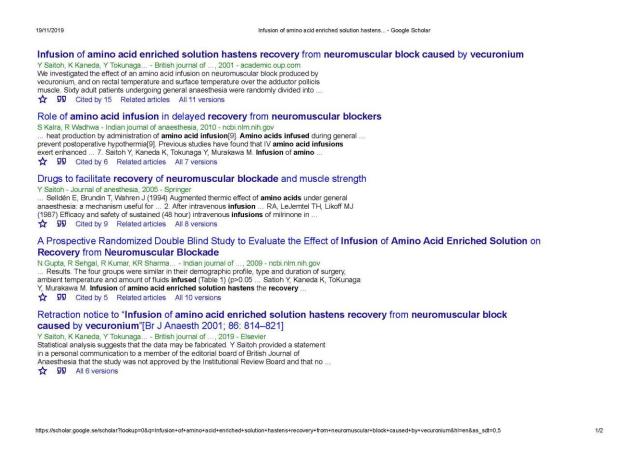☆ 𝟁𝟁   All 6 versions

Figure 3: Example of a rather anonymous retraction link further down in the search result list in Google Scholar.

Overall, Google Scholar, apart from almost always violating criterion A*, failed in both the university and home searches to list retraction links among the "best results" half of the time and to list a

retraction notice on the first page of search results one quarter of the time. Furthermore, in our sample, Google Search failed in two cases to include a retraction link at all on the first result page, and Google Scholar failed to do so in no less than five cases. In these cases, the Google user cannot tell that the article has been retracted just by looking at the first search result page.

5. Discussion

The fact that the first link in our study on Google Search and Google Scholar were almost always an article link and not a retraction link, even though the article had been retracted, is particularly disturbing in relation to what has been referred to as "top link heuristics" (Pan et al. 2007, Salmerón et al., 2013). Salmerón (2019, p. 1, references removed) writes:

> Search engine results pages (SERPs) are a frequent gateway to Internet content. Prior research has extensively documented strong effects of SERPs (e.g. rank order or the spatial distribution of the results) on users' attention to and selection of particular Web pages. In the context of Web search, a common user behavior is the 'top link' or 'Google trust' heuristic, that is, the inspection and selection of only the first few search results presented by the search engine, without evaluating all other search results available. This heuristic behavior allows users to find information in an efficient way, as search engines tend to provide relevant documents on top of the list, especially when it comes to simple facts. But just relying on the top results of the SERP to access information may not be as efficient when users search for learning purposes about controversial topics, such as climate change, for at least two reasons. First, users can be easily mislead by, for example, commercially biased Web Pages located on top of the SERP. Second, by looking at just few hits users miss the opportunity to use SERP information to reflect on the relationships between available web pages, an essential step when learning about controversial topics.

Our study indicates that the top link heuristic may not be "efficient" even when it comes to some "simple facts", such as the indubitable fact that a scientific article has been retracted.

Effectively, rather than dealing with retractions itself, Google "oursources" the problem, counting on scientific journals to include a retraction notice on the webpages of retracted articles. In our sample, many journals had indeed included a retraction notice on the webpage of the retracted article, so that when users click on the article link in Google Search, they are directed to a page with a visible retraction notice. Unfortunately, it has been observed that "[n]ot all publishers, for instance, publicize or clearly label papers they have retracted, or explain why they did so" (Brainard and You, 2018).[4]

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[4] Cf. Teixeira da Silva and Bornemann-Cimenti (2017), p. 365: "COPE guidelines state that the 'retracted status should be indicated as clearly as possible', but this is definitely not true for many retracted publications. Likewise, databases do not consequently link retracted articles with the notice of retraction. Furthermore, many papers are deposited in the 'original', i.e. pre-retraction version on personal or institutional websites or

This practice of outsourcing supports our earlier conjecture that retracted articles are a deep problem for Google and similar search engines relying on popularity metrics. After all, had there been a quick fix, Google (or Alphabet, as the company is now called) would have found it and solved the problem inside the search engine itself rather than relying on journals to visibly include information about retractions.

Our study raises a number of questions for future work. The overarching question is of course whether actual users of Google are in fact misled by the way Google handles retractions due to fraud? Do they, as a result, come to entertain false scientific beliefs? Our results indicate that Google almost always ranks an article link higher than a retraction link. In order to investigate whether users are actually misled by Google's practice, it would probably be necessary to set up an empirical experiment with real subjects and study their search behavior and beliefs before and after search. To the best of our knowledge, no such experiment has yet been carried out. A factor that might be of interest here is the relative proportion of links to the original article and retraction links on the first Google page. Conceivably, a majority of retraction links in relation to article links might convince a user that the article has been retracted and *vice versa*.

A further, pressing issue for future study concerns identifying the best policy for handling retracted articles in order to prevent fake science from being disseminated through search engines such as Google. One approach is to leave search engines more or less as they are, including their ultimate reliance on popularity as a significant determinant of the ranking of search results, and to outsource the task of informing about retractions to the scientific journals. As we have seen, this is essentially how Google (at the time of writing this article) solves this problem. A difficulty with this approach is that links to retracted articles receives unwanted attention in the list of search results in a way that could potentially mislead user. A further issue is that the strategy assumes that journals generally take their responsibility vis-à-vis retractions, which, again, is not always the case. A second kind of solution would be to solve the problem within the search engine itself, i.e. to develop search algorithms that have an "organic" preference for retraction links, in the sense that such preference is a consequence of the algorithms themselves. However, search engine providers will be unwilling to make radical changes to a technology that has served them so well. Thus, it is unlikely that they will consider moving away from the underlying technology. A less radical proposal for algorithmic change would be for Google and others to store retracted information in a special database, much like

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online repositories. Similarly, printed 'stock files' are obviously unaffected by a retraction. Clear identification of a retracted article using a watermark and in databases is a crucial step while incorporation of an electronic 'retraction check' in reference management software and during the online submission is necessary to detect and avoid citing retracted literature. Solving this problem needs the close attention of everybody involved in the publishing process: authors, reviewers, and publishers."

Retraction Watch does, and tweak their algorithms so that the fact that information has been retracted overrides other considerations, such as popularity. Of course, these two approaches are not mutually exclusive: both search engine providers and scientific journals could take greater responsibility for how they handle retracted articles.

In our study, the search term constituted the (complete) title of the article. Initial tests suggest that searching on key words in the title rather than on the title itself can give different results vis-à-vis the ranking of article links *versus* retraction links. In one case, a retraction link was ranked second when searching on the title but ranked somewhere in the middle when searching on keywords. Other possible options would be combinations of keywords attached to the abstract of the article, when available, or titles of popular science or generalist media articles referencing the retracted article, when available. As for the latter, anecdotal evidence suggests that article titles are seldom included verbatim in popular science or generalist media coverage, but that the articles are usually linked to. Thus, a non-specialist reader following the link could have access to the article title as published, and later search for it. Alternatively, titles and taglines of popular science and generalist media coverage are likely the first exposure of non-specialists readers to the content of retracted article, and are thus a natural choice for online searches.

In cases of popular science or non-specialist accounts of articles that were later retracted, we may ask how often the outlet in question includes a retraction notice after the retraction. If this does not happen on a regular basis, would it be useful to have a service that informed the outlet that content on its website relies on a retracted scientific article?

6. Conclusion

Our initial case study showed that fake science, in the sense of articles that have been retracted due to fraud, can still be visible in Google, and thus potentially disseminated via the search engine, even after the articles has been retracted. We hypothesized that the reason for this lies in the popularity-based logic governing Google, in particular its foundational PageRank algorithm, in conjunction with a psychological law which we refer to as the "law of retraction": a retraction is typically (though not universally) taken to be less interesting and therefore less popular with internet users than the original content retracted. We performed a pilot study of the relative ranking of retractions due to fraud (fabrication of data) drawing on records of retracted articles in the *Retraction Watch* public database. The study tested, specifically, the extent to which article links, i.e. links with the title of the retracted article, are still highly ranked in Google – and more so than retraction links, i.e. links starting with "retraction" or "retraction notice" followed by the title of the retracted paper.

In our sample, Google Search almost always ranked article links higher than retraction links, apparently judging article links to be more important or relevant than retraction links. This was in conformity with one of our main hypotheses (H1). We thought that the problem would be less severe in Google Scholar (H2, H3). However, this turned out to be false: Google Scholar, too, consistently ranked article links higher than retraction links. Moreover, Google Scholar often failed to list retraction links among the "best results" for a title search, and in five cases failed to include a retraction link at all on its first result page!

The study reported here is a smaller-scale pilot study including 24 retracted article from a given period in time, and one should be careful about drawing general conclusions. In particular, the results should not be taken as proof that users will generally be misled by the way Google Search and Google Scholar handle retractions due to fraud. Even so, the results are quite striking and it would be surprising if including more retracted articles would yield a radically different result vis-à-vis our hypotheses, unless of course Google chooses to update its current search algorithms in decisive ways to deal with the problem.

To clarify, we do not claim that Google is guilty of producing fake science, of course; those responsible are the scientists in question. We do think, however, that our study indicates that Google risks disseminating fake science through its ranking algorithms. Finally, our study supports our initial conjecture that it is not easy to handle the problem of retracted article within Google itself. Rather than tweaking its algorithms to make retraction links more highly ranked than the corresponding article link, Google has in effect "outsourced" the handling of retractions to the scientific journals issuing them, counting on these journals to include retraction notices on the articles' webpages, which, as we saw, is an ideal yet to be universally implemented.

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