# Organized scientific fraud is growing at an alarming rate, study uncovers

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From fabricated research to paid authorships and citations, organized scientific fraud is on the rise, according to a new Northwestern University study.

By combining large-scale data analysis of scientific literature with case studies, the researchers led a deep investigation into scientific fraud. Although concerns around scientific misconduct typically focus on lone individuals, the Northwestern study instead uncovered sophisticated global networks of individuals and entities, which systematically work together to undermine the integrity of academic publishing.

The problem is so widespread that the publication of fraudulent science is outpacing the growth rate of legitimate scientific publications. The authors argue these findings should serve as a wake-up call to the scientific community, which needs to act before the public loses confidence in the scientific process.

The study, "The entities enabling scientific fraud at scale are large, resilient and growing rapidly," was published in the *Proceedings of the National Academy of Sciences.*

"Science must police itself better in order to preserve its integrity," said Northwestern's Luís A. N. Amaral, the study's senior author.

"If we do not create awareness around this problem, worse and worse behavior will become normalized. At some point, it will be too late, and scientific literature will become completely poisoned. Some people worry that talking about this issue is attacking science. But I strongly believe we are defending science from bad actors. We need to be aware of the seriousness of this problem and take measures to address it."

An expert in complex social systems, Amaral is the Erastus Otis Haven Professor and professor of engineering sciences and applied mathematics at Northwestern's McCormick School of Engineering. Reese Richardson, a postdoctoral fellow in Amaral's laboratory, is the paper's first author.

## Extensive analysis

When people think about scientific fraud, they might remember news reports of retracted papers, falsified data or plagiarism. These reports typically center around the isolated actions of one individual, who takes shortcuts to get ahead in an increasingly competitive industry. But Amaral and his team uncovered a widespread underground network operating within the shadows and outside of the public's awareness.

"These networks are essentially criminal organizations, acting together to fake the process of science," Amaral said. "Millions of dollars are involved in these processes."

To conduct the study, the researchers analyzed extensive datasets of retracted publications, editorial records and instances of image duplication.

Most of the data came from major aggregators of scientific literature, including Web of Science (WoS), Elsevier's Scopus, National Library of Medicine's PubMed/MEDLINE and OpenAlex, which includes data from Microsoft Academic Graph, Crossref, ORCID, Unpaywall and other institutional repositories.

Richardson and his colleagues also collected lists of de-indexed journals, which are scholarly journals that have been removed from databases for failing to meet certain quality or ethical standards.

The researchers also included data on retracted articles from Retraction Watch, article comments from PubPeer and metadata—such as editor names, submission dates and acceptance dates—from articles published in specific journals.

## Buying a reputation

After analyzing the data, the team uncovered coordinated efforts involving "paper mills," brokers and infiltrated journals. Functioning much like factories, paper mills churn out large numbers of manuscripts, which they then sell to academics who want to quickly publish new work.

These manuscripts are mostly low quality—featuring fabricated data, manipulated or even stolen images, plagiarized content and sometimes nonsensical or physically impossible claims.

"More and more scientists are being caught up in paper mills," Amaral said. "Not only can they buy papers, but they can buy citations. Then, they can appear like well-reputed scientists when they have barely conducted their own research at all."

"Paper mills operate by a variety of different models," Richardson added.

"So, we have only just been able to scratch the surface of how they operate. But they sell basically anything that can be used to launder a reputation. They often sell authorship slots for hundreds or even thousands of dollars. A person might pay more money for the first author position or less money for a fourth author position. People can also pay to get papers they have written automatically accepted in a journal through a sham peer-review process."

To identify more articles originating from paper mills, the Amaral group launched a parallel project that automatically scans published materials science and engineering papers. The team specifically looked for authors who misidentified instruments they used in their research. A paper with those results was accepted by the journal *PLOS ONE*.

## Brokers, hijacking and collusion

Amaral, Richardson and their collaborators found fraudulent networks use several key strategies:

1. Groups of researchers collude to publish papers across multiple journals. When their activities are discovered, the papers are subsequently retracted;
2. Brokers serve as intermediaries to enable mass publication of fraudulent papers in compromised journals;
3. Fraudulent activities are concentrated in specific, vulnerable subfields;
4. Organized entities evade quality-control measures, such as journal de-indexing.

"Brokers connect all the different people behind the scenes," Amaral said. "You need to find someone to write the paper. You need to find people willing to pay to be the authors. You need to find a journal where you can get it all published. And you need editors in that journal who will accept that paper."

Sometimes these organizations go around established journals altogether, searching instead for defunct journals to hijack. When a legitimate journal stops publishing, for example, bad actors can take over its name or website. These actors surreptitiously assume the journal's identity, lending credibility to its fraudulent publications, despite the actual publication being defunct.

"This happened to the journal HIV Nursing," Richardson said. "It was formerly the journal of a professional nursing organization in the U.K., then it stopped publishing, and its online domain lapsed. An organization bought the domain name and started publishing thousands of papers on subjects completely unrelated to nursing, all indexed in Scopus."

## Fighting for science

To combat this growing threat to legitimate scientific publishing, Amaral and Richardson emphasize the need for a multi-prong approach. This approach includes enhanced scrutiny of editorial processes, improved methods for detecting fabricated research, a greater understanding of the networks facilitating this misconduct and a radical restructuring of the system of incentives in science.

Amaral and Richardson also underscore the importance of addressing these issues before artificial intelligence (AI) infiltrates scientific literature more than it already has.

"If we're not prepared to deal with the fraud that's already occurring, then we're certainly not prepared to deal with what generative AI can do to scientific literature," Richardson said.

"We have no clue what's going to end up in the literature, what's going to be regarded as scientific fact and what's going to be used to train future AI models, which then will be used to write more papers."

"This study is probably the most depressing project I've been involved with in my entire life," Amaral said. "Since I was a kid, I was excited about science. It's distressing to see others engage in fraud and in misleading others. But if you believe that science is useful and important for humanity, then you have to fight for it."

**More information:** The entities enabling scientific fraud at scale are large, resilient and growing rapidly, *Proceedings of the National Academy of Sciences* (2025). DOI: 10.1073/pnas.2420092122