

## PUBLISHING

# Citation manipulation found to be rife in math

Problem is so severe that an influential top-researchers list has excluded the entire field

By Michele Catanzaro

**C**liques of mathematicians at institutions in China, Saudi Arabia, and elsewhere have been artificially boosting their colleagues' citation counts by churning out low-quality papers that repeatedly reference their work, according to an unpublished analysis seen by *Science*. As a result, their universities—some of which do not appear to have math departments—now produce a greater number of highly cited math papers each year than schools with a strong track record in the field, such as Stanford and Princeton universities.

These so-called “citation cartels” appear to be trying to improve their universities' rankings, according to experts in publication practices. “The stakes are high—movements in the rankings can cost or make universities tens of millions of dollars,” says Cameron Neylon, a professor of research communication at Curtin University. “It is inevitable that people will bend and break the rules to improve their standing.” In response to such practices, the publishing analytics company Clarivate has excluded the entire field of math from the most recent edition of its influential list of authors of highly cited papers, released in November 2023.

The startling new analysis is the work of Domingo Docampo, a mathematician at the University of Vigo with a long-standing interest in university ranking systems. Over the past few years, Docampo had noticed that Clarivate's list of highly cited researchers (HCRs) was gradually being taken over by lesser known mathematicians. “There were people that published in journals that no serious mathematician reads, whose work was cited by articles that no serious mathematicians would read, coming from institutions that nobody knows in mathematics,” he says. So he decided to delve into Clarivate's data from the past 15 years to explore exactly which universities were publishing highly cited papers and who was citing them.

The data showed that between 2008 and 2010, institutions such as the University of California, Los Angeles (UCLA) and Princeton produced the greatest number of highly cited math papers (defined as the top 1% by citation number), with 28 and 27, respectively. But in 2021 to 2023, institutions with

little mathematical tradition, many based in China, Saudi Arabia, and Egypt, had displaced them. In this period, China Medical University in Taiwan topped the list with 95 highly cited math papers—compared with none a decade earlier. UCLA, meanwhile, had just a single highly cited paper.

Docampo found patterns that suggested citation cartels were at work. Most telling, the citations to the top papers often came from researchers at the same institution as the cited paper's authors. For instance, between 2021 and 2023, two prolific publishers of highly cited papers—China Medical University and King AbdulAziz University, which boasted 66 top papers in that period—each also published hundreds of studies referencing highly cited papers. The studies that



referenced highly cited papers were also regularly published in predatory journals, Docampo found, where rogue citation practices may be more easily accepted.

Other scientists agree that the evidence points to widespread citation manipulation. “We have a number of researchers trying to boost their citations artificially in a manner that does not at all reflect their scientific quality,” says Helge Holden, chair of the Abel Prize committee, one of the most prestigious awards in math. “This can only be condemned.”

Yueh-Sheng Chen, chief secretary of China Medical University, says his university did not engage in the practice. “We know nothing about the targeted citation and are not involved in such manipulation,” he says. The

involvement of “internationally renowned experts and scholars in fields such as applied mathematics” is part of the institution's interdisciplinary approach to medicine, he adds. King AbdulAziz University did not reply to *Science*'s request for comment.

Clarivate declined to comment on the issue. However, in online statements about its decision to exclude mathematicians from the most recent HCR list, the company says it was concerned by “strategies to optimize status and rewards through publication and citation manipulation, especially through targeted citation of very recently published papers.” Math is especially vulnerable to manipulation because the field is small, the company writes. “The average rate of publication and citation ... is relatively low, so small increases in publication and citation tend to distort the representation and analysis of the overall field.”

But citation manipulation is happening in other, larger disciplines, too, says Félix de Moya Anegón, a bibliometrician at the University of Granada—it's just not as visible. Ilka Agricola, chair of the Committee on Electronic Information and Communication of the International Mathematical Union, worries that by singling out math, Clarivate may have conveyed the impression that the field is infiltrated by “fraudulent scientists.” “We very much regret that no other option was seen than to no longer list mathematics at all,” she says.

Clarivate says it is taking “advice from external experts ... to discuss our future approach to the analysis of this field.”

Docampo is working on a more refined metric, which weights citations according to the quality of the citing journals and institutions.

Other researchers say citation manipulation is simply a symptom of a flawed system of evaluation. Citations and similar metrics are not refined enough to monitor individual performance, says Ismael Rafols, a researcher at the Centre for Science and Technology Studies of the University of Leiden, and people are always going to find ways to game the system. Holden agrees: “The bottom line is that citations are not a good measure of scientific quality.” ■

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