Characteristic Analysis and Implications of Retracted Papers in High-Impact International Scientific Journals: A Case Study of Cell, Nature, and Science

Authors: Yuan Zihan, Jin Tong, Jin Tong

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Abstract

Objective: Analyzing the characteristics and reasons for retraction of papers in high-impact international journals facilitates a deeper understanding of the retraction phenomenon and provides a reference for the governance of retracted papers and promoting research integrity. Methods: We collected 232 retracted papers from Cell, Nature, and Science since their inception, and analyzed basic characteristics such as temporal trends, retraction lags, disciplinary distribution, reasons for retraction, retraction subjects, and citation frequencies before and after retraction using scientometric methods. Results: Over the past 20 years, the number of retracted papers has shown a fluctuating upward trend; basic life sciences accounts for the highest number of retracted papers; the vast majority of retracted papers have corresponding author affiliations in scientific and technological powers such as the United States, United Kingdom, and Germany; papers continue to receive substantial citations after retraction; the primary reasons for retraction are falsified data/images and unreliable conclusions, with non-reproducible results constituting a serious problem; the number of papers retracted due to honest errors far exceeds those retracted for research misconduct. Conclusions: We should develop a correct understanding of the phenomenon of journal retractions, address the challenges that the "reproducibility crisis" poses to the governance of research misconduct, thoroughly summarize the underlying causes of honest retractions, strengthen independent analysis of papers retracted for research misconduct, and further explore the citation value and citation norms of retracted papers.

Full Text

Analysis of Retracted Papers in High-Impact International Scientific Journals: A Case Study of Cell, Nature, and Science

YUAN Zihan[1], **JIN Tong**[2]
[1] Library of Capital Normal University, No. 83 West Third Ring North Road, Haidian District, Beijing 100048, China
[2] Library of Capital University of Economics and Business, 121 Zhangjiakou Road, Fengtai District, Beijing 100070, China

Abstract
Purpose: Analyzing the characteristics and reasons for retractions in high-impact international journals helps deepen our understanding of the retraction phenomenon and provides a reference for managing retracted papers and constructing research integrity systems. **Methods:** This study collected 232 retracted papers published in *Cell*, *Nature*, and *Science* since their inception, using bibliometric methods to analyze basic characteristics including temporal trends, retraction time lags, disciplinary distribution, reasons for retraction, retraction initiators, and citation frequencies before and after retraction. **Findings:** The number of retracted papers has fluctuated and increased over the past two decades. Basic life sciences accounts for the largest number of retractions, with the vast majority of corresponding addresses located in scientific powerhouses such as the United States, United Kingdom, and Germany. Retracted papers continue to receive substantial citations after retraction. The primary reasons for retraction are falsified data/images and unreliable conclusions, with serious problems regarding non-reproducible results. The number of papers retracted for honest errors far exceeds those retracted for scientific misconduct. **Conclusions:** We should correctly understand the journal retraction phenomenon, pay attention to the challenges posed by the "reproducibility crisis" to misconduct governance, deeply examine the true motivations behind honest retractions, strengthen independent analysis of misconduct retractions, and further explore the citation value and norms for retracted papers.

Keywords: High-impact journals; Retracted papers; Research integrity; Scientific misconduct

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YUAN Zihan: Research design, literature review, writing and revising the manuscript; JIN Tong: Research design, data collection and analysis, manuscript revision.

2 Research Design

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Authors' Information: YUAN Zihan (ORCID: 0000-0002-5114-0084), Master, Librarian, E-mail: yuanzihan@cnu.edu.cn; Corresponding Author: JIN Tong (ORCID: 0000-0001-8081-0238), Master, Librarian, E-mail: jintong@cueb.edu.cn.

2.1 Sample Selection

This study selected *Cell*, *Nature*, and *Science* (hereinafter referred to as CNS) as representatives of high-impact international journals for the following reasons: First, CNS journals are internationally recognized as having the highest academic reputation and are highly sought-after venues for publishing cutting-edge scientific achievements. Papers published in CNS journals hold significant global importance in terms of both scientific significance and academic caliber. Second, CNS retraction incidents have occurred with increasing frequency in recent years, attracting widespread academic discussion. As top-tier international scientific journals, CNS publications maintain rigorous peer review processes and standardized publication ethics. Analyzing their retracted papers can clarify the basic characteristics of high-impact retractions, deepen related research, and provide valuable lessons for retraction management. Third, compared to retractions in ordinary journals, CNS retractions carry substantial influence, maintaining high citation frequencies both before and after retraction, thus possessing greater research value.

2.2 Research Framework

First, we collected bibliographic information, original retracted articles, and retraction notices for CNS retracted papers. Second, we conducted a comprehensive analysis of basic academic characteristics, including temporal trends, retraction time lags, disciplinary distribution, reasons for retraction, retraction initiators, and citation frequencies before and after retraction. Third, based on this characteristic analysis, we summarized the research integrity and scientific ethics issues reflected in CNS retractions. Finally, we discussed relevant issues and proposed policy recommendations for retraction management and research integrity system construction.

2.3 Data Collection

Bibliographic information for CNS retracted papers was obtained from the Retraction Watch database (hereinafter RW database) and the Web of Science database (hereinafter WOS database). Although both databases include CNS retractions, comparison revealed that the RW database provides more comprehensive coverage and more complete records, including titles, all authors, affiliations, retraction reasons, retraction dates, DOIs, publishers, etc. Therefore, we

selected the RW database as our primary data source, supplemented by citation frequency data from WOS. The specific search strategy involved entering "Cell," "Nature," and "Science" in the "Journal" field of the RW database, which returned 353 results. These results included retracted articles, retraction notices, and editorial expressions of concern, some referring to the same paper. After deduplication, 232 bibliographic records of retracted papers remained for statistical analysis in Excel. Retraction notice texts were obtained from ScienceDirect, Science, and Nature full-text databases, with supplementary searches in Sci-Hub. After multiple rounds of searching, 4 retraction notices could not be located, yielding a final collection of 228 retraction notice texts.

3.1 Temporal Distribution and Retraction Time Lag

The earliest CNS retraction was "Unmineralized Fossil Bacteria" published in *Science* on September 6, 1963, and retracted on August 26, 1968. Figure 1 [Figure 1: see original paper] shows the number of CNS retractions and publications. The figure clearly reveals: (1) From 1968 to the present, CNS annual publication numbers have remained relatively stable, while retraction numbers have fluctuated significantly. (2) The temporal trend in retractions can be divided into two distinct phases: Phase 1 (1968-2002) saw few retractions with sporadic incidents; Phase 2 (2002-present) has witnessed fluctuating but overall increasing retraction numbers, with annual counts never falling below 4, peaking at 15 in 2003, and reaching 14 in both 2014 and 2020. Some scholars suggest that global growth in publication volume is a major factor driving increased retractions. However, our comprehensive analysis found that CNS retraction numbers do not correlate with publication volume changes, with both the absolute number and proportion of retractions showing an overall upward trend.

By comparing publication dates and retraction dates, we further analyzed CNS retraction time lags. We found that 75 papers had retraction lags of less than 500 days, 66 had lags between 500-1000 days, and 91 had lags exceeding 1000 days, with an average retraction lag of approximately 1401 days. This indicates that errors or misconduct in most CNS retracted papers are discovered or identified within 3 years, though a minority have retraction lags exceeding 10 years.

3.2 Disciplinary Distribution

The RW database categorizes disciplines into seven major categories: Business/Technology, Environmental Science, Health Science, Natural Science, Basic Life Science, Social Science, and Humanities, with detailed subcategories. Based on RW disciplinary classifications, we analyzed CNS retraction distribution (see Table 1 ; some retractions involved multiple disciplines, resulting in duplicate counts). At the major category level, Basic Life Science had the most retractions (443 counts, approximately 71.11% of the total), followed by Natural Science (115 counts, about 18.46%). Health Science (36 counts) and

Environmental Science (22 counts) were relatively small, while Social Science, Business/Technology, and Humanities had only 4, 2, and 1 retractions respectively. At the subcategory level, Molecular Biology ranked highest with 111 counts (approximately 17.82% of the total), followed by Cell Biology (90 counts, 14.45%) and Genetics (79 counts, 12.68%). Biology, Physics, and Chemistry had numerous retractions, consistent with CNS journals' scope and focus, though a small number of humanities and social sciences papers in Sociology and Religious Studies were also retracted.

Table 1: Disciplinary Distribution of CNS Retracted Papers

Major Category	Subcategories (Count)
Basic Life Science	Molecular Biology (111), Cell Biology (90), Genetics (79), Biochemistry (60), General Biology (27), Neuroscience (15), Microbiology (14), etc.
Natural Science	Physics (33), Chemistry (32), Electrical Engineering (13), Materials Science (10), etc.
Health Science	Immunology (12), Pharmacology (8), Endocrinology (2), etc.
Environmental Science	Environmental Science (8), Ecology (6), Climatology (2), etc.
Social Science	Leisure Sports (2), Sociology (1), Political Science (1)
Business/Technology	Computer Science (2)
Humanities	Religious Studies (1)

3.3 Geographic Distribution

Analyzing corresponding authors' countries, we found that 232 CNS retracted papers originated from 33 countries. The top 10 countries were: United States (156 papers), United Kingdom (38), Germany (35), Japan (21), France (13), Switzerland (13), Netherlands (10), China (10), Canada (8), and Sweden (6) (Note: Some retractions had multiple corresponding authors, so the sum exceeds 232). Comparing these countries' publication and retraction numbers in CNS journals (see Figure 2 [Figure 2: see original paper]), the United States ranked first in both metrics, exceeding the combined total of the next nine countries, with a slightly higher retraction proportion than publication proportion. The United Kingdom showed roughly equal publication and retraction proportions. However, Germany and Japan had publication proportions far lower than retraction proportions: Germany's publication share was approximately 4.14% versus 9.92% for retractions, while Japan's was 2.29% versus 5.95%—more than double. In other words, Germany and Japan published relatively fewer papers but had disproportionately more retractions, a pattern also observed in Switzer-

land, Netherlands, and China. Generally, higher retraction numbers correlate with larger publication bases, making publication and retraction proportions roughly proportional. However, our data show that CNS retraction geographic distribution does not fully follow this pattern.

3.4 Reasons for Retraction

Classifying retraction reasons is complex. Although the RW database annotates reasons for each retraction, research indicates these annotations are not entirely accurate or reliable, often being overly comprehensive while obscuring the nature of the retraction reasons. Therefore, we did not directly adopt RW's classifications. Instead, after reading all 228 retraction notices, we developed a classification system for CNS retraction reasons (see Table 2) based on the "Academic Publishing Standards: Definition of Academic Misconduct in Journals" issued by the National Press and Publication Administration, and referencing classification systems by scholars such as Wu Renli and Jin Tong. This system comprises 4 primary categories (Scientific Misconduct, Honest Error, Research Ethics, and Other) and 16 secondary categories. Classification criteria were: Scientific Misconduct: retraction notice explicitly mentions falsification or plagiarism; Honest Error: notice explicitly mentions non-intentional errors such as sample contamination, research design flaws, or calculation errors, with authors voluntarily requesting retraction after discovering mistakes post-publication; Research Ethics: notice explicitly mentions ethical violations such as lack of ethics approval or informed consent violations; Other: no clear reason given or retraction notice unavailable.

Data show that "Honest Error" retractions were most numerous (146 papers, approximately 62.93% of the total), including unreliable conclusions (46), data analysis errors (37), non-reproducible results (36), and unreliable data/images (10). Based on retraction notice content, unreliable conclusions fall into two types: earlier papers where technological advances or expanded samples yielded new conclusions that rendered original conclusions unreliable; and more recent papers where authors discovered data analysis errors or design flaws during replication attempts, making some conclusions unreliable. Though other conclusions remained valid and no misconduct was involved, authors chose to retract out of scientific rigor. "Scientific Misconduct" retractions ranked second (77 papers, about 33.19%), with "Falsified Data/Images" being the most common reason (75 papers). While plagiarism remains a major retraction reason in other journals and disciplines, only 1 CNS retraction was due to plagiarism. "Research Ethics" and "Other" retractions were minimal (3 and 9 papers respectively).

Overall, data and image issues dominate retraction reasons. Notably, honest error retractions far exceed misconduct retractions by a ratio of approximately 2:1. This contrasts with studies suggesting most retractions result from misconduct, a discrepancy worthy of careful consideration.

Table 2: Distribution of CNS Retraction Reasons

Primary Category	Secondary Category	Count	Percentage
Scientific Misconduct	Falsified Data/Images	75	32.33%
	False Funding Information	1	0.43%
	Plagiarism	1	0.43%
Honest Error	Unreliable Conclusions	46	19.83%
	Data Analysis Errors	37	15.95%
	Non-reproducible Results	36	15.52%
	Unreliable Data/Images	10	4.31%
	Sample Contamination	7	3.02%
	Methodological Errors	6	2.59%
	Research Design Flaws	2	0.86%
	Original Data Loss	1	0.43%
Research Ethics	Ethics Violations	1	0.43%
	Publication Ethics Violations	2	0.86%
Other	No Clear Reason Stated	5	2.16%
	Retraction Notice Not Found	4	1.72%

3.5 Discovery Mechanisms and Retraction Initiators

Retraction notices document important information including how misconduct/errors were discovered, retraction initiators, reader inquiries, official investigation results, and author responses. The first two elements are most detailed, so we extracted this key information to create Figure 3 [Figure 3: see original paper] and Figure 4 [Figure 4: see original paper]. Data show that "Author Self-Detection" was the primary discovery pathway (76 papers, about 33%). Based on retraction notices, some authors requested retraction shortly after publication when their teams could not replicate results, while others did so years later when new technologies or methods revealed errors in their work. "Third-party Questioning/Reporting" was another major pathway (58 papers), where investigations were initiated following third-party reports and confirmed misconduct led to retraction, accounting for about 25% of the total. Third-party questioning/reporting included: other teams' inability to replicate results, experimental falsification of conclusions, identification of data/calculation errors, and direct reports of fabrication. Official investigations confirmed misconduct or errors in 39 papers (about 17%), conducted primarily by editorial offices, peer experts commissioned by editors, authors' institutions, or national research integrity offices. Additionally, 11 retractions involved co-author reports of first-author misconduct, and 2 involved authors admitting fabrication.

Regarding retraction initiators, authors themselves were the primary initiators, requesting retraction for 196 papers (86% of the total). This includes both voluntary retractions after discovering honest errors (151 papers) and forced retractions after being investigated for misconduct (45 papers). Journals initiated 25 retractions (about 10%), all for scientific misconduct. Co-author reports led

to 3 retractions, and institutional confirmation of misconduct led to 1 retraction.

3.6 Citation Frequency

Using WOS data, we analyzed citation frequencies before and after retraction (see Figure 5 [Figure 5: see original paper]). The 232 retracted papers received 31,705 total citations, averaging 136.7 citations per paper, with 20,120 citations before retraction and 11,585 after. Retraction does not terminate citations; on the contrary, CNS papers continue to receive substantial post-retraction citations, with approximately one-third of all citations occurring after retraction. Some papers even received all their citations post-retraction.

We further compared citation frequencies between honest error and misconduct retractions (see Table 3 ; research ethics and other retractions were excluded due to small sample sizes). In absolute terms, honest error retractions received about 1.5 times more pre-retraction citations than misconduct retractions, expanding to 2 times more post-retraction, likely due to their higher proportion in the sample. In relative terms, per-paper citation rates were comparable: pre-retraction, honest error retractions averaged 76.97 citations versus 107.89 for misconduct retractions; post-retraction, honest error retractions averaged 52.99 citations versus 42.07 for misconduct retractions. Overall, honest error retractions surpassed misconduct retractions in both total and average post-retraction citations.

Table 3: Citation Frequency Comparison Between Honest Error and Misconduct Retractions

Category	Pre-Retraction Citations	Pre-Retraction Average	Post-Retraction Citations	Post-Retraction Average
Honest Error	11,237 (55.85%)	76.97	7,737 (67.56%)	52.99
Misconduct	8,306 (41.29%)	107.89	3,486 (28.29%)	42.07

4 Main Research Conclusions

4.1 Basic Characteristics of Retracted Papers

(1) **CNS retraction numbers have fluctuated and increased since the 21st century.** Before the 1990s, CNS retractions were rare and sporadic. After 2002, retraction numbers increased with fluctuations, reaching peaks of 15 papers in certain years. Comparative analysis of retraction and publication numbers reveals that retraction counts do not correlate with publication volume changes, instead reflecting global research misconduct governance practices. The establishment of the U.S. Office of Research

Integrity in 1992 marked government intervention in misconduct cases. Subsequent European and American legislation gradually strengthened misconduct governance, leading to increased exposure and investigation of fraudulent CNS papers and rising retraction numbers. With heightened global emphasis on research integrity and stricter misconduct investigations, CNS retractions will likely remain at a high plateau for some time.

(2) **Basic life sciences accounts for the most retractions, with the vast majority from scientific powerhouses like the U.S., U.K., and Germany.** 89.57% of retractions fall within basic life sciences and natural sciences, concentrated in molecular biology, cell biology, genetics, physics, and chemistry. Although CNS are natural science journals, *Nature* and *Science* occasionally publish humanities and social sciences research, with 5 retracted papers from sociology and religious studies. Over half of retractions originate from the U.S., U.K., and Germany—countries with high publication volumes but varying publication-to-retraction ratios.

(3) **CNS papers continue to receive substantial citations after retraction, with honest error retractions cited more frequently than misconduct retractions.** CNS retracted papers maintain high total and per-paper citation frequencies, reflecting significant influence and attention. Approximately one-third of citations occur post-retraction. Compared to normal publications, retracted papers often gain notoriety through media and public debate, bringing their topics to peers' attention and generating citations. Additionally, honest error retractions receive far more citations than misconduct retractions. Research suggests honest error papers contain only localized problems while retaining academic value in research design, methods, content, or results, thus attracting higher citations.

(4) **Reporting is the primary discovery mechanism for misconduct retractions.** Third-party and co-author reporting are crucial pathways for exposing misconduct in CNS papers. Most CNS publications represent cutting-edge, breakthrough research where misconduct is difficult for non-experts to detect. Even peers may fail to identify fabrication due to experimental limitations or "authority bias" toward top journals. Inherent flaws in scientific self-correction mechanisms and scientists' irrational factors combine to make misconduct detection challenging.

4.2 Reasons for Retraction

(1) **Data and image problems account for the most retractions, with serious non-reproducibility issues.** Research indicates unreliable data and images have become the leading cause of international journal retractions. Our CNS analysis confirms this, with data/image issues—including both intentional falsification and unintentional honest errors like analysis

mistakes—driving increasing numbers of non-reproducible results.

(2) **Honest error retractions far exceed misconduct retractions.** Approximately two-thirds of CNS retractions involve honest errors, while one-third involve misconduct—a 2:1 ratio. This suggests most retractions are not due to misconduct, with the majority of authors voluntarily requesting retraction upon discovering errors. In other disciplines and journals, misconduct is the primary retraction reason, with most being journal-initiated forced retractions rather than author-initiated voluntary ones. CNS retractions thus differ significantly from other retractions in both reason nature and initiation patterns.

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5 Discussion and Implications

5.1 Multiple Factors Drive Increasing Retractions; Correctly Understanding the Retraction Phenomenon

CNS retractions have fluctuated and increased since the 1990s, mirroring the sharp rise in overall retractions recorded in the RW database after 2000. Multiple factors contribute: increasing global publication volume, growing national emphasis on misconduct governance, development of detection tools, emergence of academic watchdog platforms like PubPeer, and researcher misconduct driven by performance pressures. Retractions result from multiple interacting variables, not single causes. Moreover, we should correctly understand retractions—not all result from misconduct; most CNS retractions involve honest errors with voluntary author initiation. Even misconduct retractions represent self-purification by journals and the academic community. Retraction should be viewed as a positive signal of improving integrity, a commendable self-correction mechanism that should not be stigmatized.

5.2 Addressing the "Reproducibility Crisis" Challenge to Misconduct Governance and Academic Publishing

The "reproducibility crisis" originated in psychology when Daryl J. Bem's 2011 claims of extrasensory phenomena could not be replicated. The 2015 Open Science Collaboration project found only 36% of psychology experiments reproducible, validating the crisis and spreading it to other fields. Our CNS analysis shows non-reproducible results from data/image issues have become a major retraction reason. Both misconduct and honest error retractions face reproducibility threats, posing enormous challenges to misconduct governance and open science publishing. For misconduct investigations, experimental non-reproducibility cannot definitively prove intentional fabrication. For academic publishing, peer review typically controls research design, data processing, and result analysis without requiring full experimental replication, making post-publication non-reproducibility possible even without intentional fraud. Jour-

nal editors, publishers, and science management agencies must collaborate to address potential solutions to the reproducibility crisis.

5.3 Investigating True Motivations for Honest Error Retractions and Strengthening Independent Analysis of Misconduct Retractions

Honest error retractions include cases of sample contamination, experimental mistakes, erroneous conclusions, and non-reproducible results. While notices state authors voluntarily requested retraction, questions remain: Were authors pressured to retract after facing questions? Did authors who gained improper benefits through fabrication seek to avoid exposure through "voluntary" retraction? Particularly for "non-reproducible result" retractions, distinguishing intentional from unintentional errors becomes increasingly difficult. We recommend investigating true motivations behind honest error retractions, especially frequent, proactive, or anomalous cases, requiring detailed explanations from authors and further verification by journals or institutions. We should treat genuine honest errors with tolerance while maintaining zero tolerance for misconduct disguised as honest error. Additionally, while we separately counted honest error and misconduct retractions, other bibliometric analyses did not distinguish between them. Since retraction reasons vary substantially and misconduct retractions differ fundamentally from honest error retractions, future research should exclude honest error interference and strengthen independent analysis of misconduct retractions to reveal true patterns and enable targeted governance.

5.4 Retraction Notices Do Not Fully Reflect True Retraction Reasons

Although the Committee on Publication Ethics issued detailed retraction notice guidelines in 2009, notices from the past decade still show inconsistent formatting and non-standardized content. Many notices remain vague about key information such as retraction reasons, investigation processes, and author responses, with editorial offices displaying ambiguous attitudes and even sympathetic tendencies toward authors. After reviewing all 228 notices, we found they do not fully reflect true retraction reasons. Many use euphemistic, cautious, or conservative language—possibly for academic rigor but at the cost of losing critical information, complicating data collection for retraction research. Moreover, most early notices were author-written, likely involving self-whitewashing that obscures true reasons. Future retraction research should not rely solely on notices but should integrate information from academic watchdog platforms like PubPeer and Retraction Watch for comprehensive assessment and correlation analysis to reconstruct true retraction reasons and event developments.

5.5 Exploring Citation Value and Norms for Retracted Papers

Our findings show CNS papers continue to be cited after retraction. Searching WOS and journal websites revealed at least 4 papers lacking "Retracted"

labels and without links to retraction notices in the original articles, suggesting many citing scholars may be unaware of retractions. Although retracted, these papers' research problems may retain reference value or inspire subsequent work, justifying continued citation. Honest error retractions receive higher citation frequencies than misconduct retractions, possibly because while retractions generally reduce citations (the "retraction penalty"), this penalty disappears when authors proactively report and acknowledge errors. Continued citation of retracted papers poses a real challenge for scholarly publishing. Journal editors, publishers, and authors should jointly discuss citation norms for retracted papers, theoretically and practically clarifying different citation values for misconduct retractions, honest error retractions, ethics violation retractions, and other types, addressing new ethical questions about whether, to what extent, and how retracted papers should be cited. Our position: retracted papers may be cited, but authors must explain the reason for citation and clearly label the paper as retracted.

5.6 Introducing Full-Text Citation Analysis to Retraction Research and Governance

Multiple factors explain post-retraction citations of CNS papers, including their high impact and research topic popularity. Beyond simple citation frequency analysis, we should examine citing papers' citation sentiment, intensity, and location, introducing full-text citation analysis to retraction research and governance. Citation sentiment in citing papers is particularly valuable. Journals should monitor citing papers expressing extremely positive sentiment toward misconduct retractions—if a paper retracted for misconduct receives approving citations claiming replication of its results, the citing paper may also involve misconduct, especially when authored by the original fraudster or their team members. Conversely, citing papers with negative sentiment should also be monitored, as research shows that greater pre-retraction criticism correlates with higher probability of confirmed misconduct. These negative-sentiment citing papers provide important evidence for combating serial fraud.

5.7 Mitigating Negative Impacts of Long-Retraction-Lag Papers

The average CNS retraction lag is approximately 3.8 years (1401 days), comparable to the international journal average of 3.6 years. However, some papers have retraction lags exceeding 10 years, indicating that detecting fabrication or errors is a lengthy process. While high-impact journals possess strong self-purification capacity, long-retraction-lag papers in these journals generate greater negative impacts. Journals, authors, and indexing databases should collaborate to mitigate these impacts. Journals should disclose more retraction information, as studies show greater transparency improves purification effects, by developing clear retraction policies and publishing detailed reasons, investigation processes, and outcomes. Authors should verify reference publication status to avoid improper secondary citations and must explain reasons for citing retracted papers

while labeling them as retracted. Indexing databases should promptly mark retracted papers with "Retracted" labels and link to retraction notices, especially for highly cited retractions, strengthening status alerts. Through joint efforts, we can effectively reduce adverse effects of long-retraction-lag papers and enhance academic purification.

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6 Conclusion

Using CNS retracted papers as a case study, this research analyzed basic characteristics including temporal trends, retraction lags, disciplinary distribution, retraction initiators, and pre-/post-retraction citation frequencies, providing actionable insights for retraction management and research integrity system construction. Our retraction reason classification system also offers a reference for future research. However, limitations include: (1) the small sample size of only 232 retractions from three journals; (2) failure to conduct independent analysis of misconduct retractions when examining basic characteristics. Future research should expand samples by selecting high-impact journals across different disciplines and strengthen independent analysis of misconduct retractions to generate more targeted conclusions and governance measures.

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Note: Figure translations are in progress. See original paper for figures.