Investigating the Relationship Between Academic Innovation, Visibility, and Impact: A Case Study of Leading and Key Journals Under the Excellence Action Plan for Chinese STM Journals Postprint

Authors: Li Ning, Jia Zejun, Wu Jian

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Abstract

[Objective] From a combinatorial innovation perspective, this study quantifies the innovative value of papers and explores the relationship between academic innovation and the attention and influence of scientific journal papers, providing data support for understanding the role of innovation in academic communication. Methods Using 19,278 papers published in leading and key journals of the "Excellence Action Plan" from 2018-2020 as samples, negative binomial regression was employed to analyze the correlation between academic innovation and attention/influence. Results Academic innovation of papers was positively correlated with both attention and influence (all $P<0.05$), and these findings were robust. Conclusion Academic innovation of papers is not only an effective means to enhance their attention but also a key factor in improving their influence. Therefore, it is recommended to: identify global research trends and plan interdisciplinary special issues; enhance editors' academic acumen to precisely identify innovative papers; form interdisciplinary review teams to ensure review precision.

Full Text

Exploring the Relationship Between Academic Novelty, Attention, and Impact: A Case Study of Leading and Key Journals Under the Excellence Action Plan for China STM Journals

Li Ning[1], **Jia Zejun**[2], **Wu Jian**[1,3]
[1] School of Economics and Management, Shanghai University of Sport, No. 650

Qingyuanhuan Road, Yangpu District, Shanghai 200438, China
[2] Journal Publishing Center, Zhongshan Hospital Fudan University, No. 1609 Xietu Road, Xuhui District, Shanghai 200032, China
[3] Journal Publishing Center, Shanghai University of Sport, No. 650 Qingyuanhuan Road, Yangpu District, Shanghai 200438, China

Abstract

[**Purposes**] This study quantifies the novelty value of papers from the perspective of combinatorial novelty and explores the relationship between academic novelty, attention, and impact in scientific journal papers, providing data support for understanding the role of novelty in academic dissemination.

[**Methods**] Using 19,278 papers published in leading and key journals under the "Excellence Action Plan" from 2018 to 2020 as the sample, negative binomial regression was employed to analyze the correlation between academic novelty and both attention and impact.

[**Findings**] The results reveal a positive correlation between academic novelty and both attention and impact ($P < 0.05$ for both), and this finding is robust.

[**Conclusions**] Academic novelty in papers is not only an effective means to increase attention but also a key factor in enhancing their impact. Recommendations include assessing global research trends to plan interdisciplinary special issues, enhancing editorial academic sensitivity to accurately identify innovative papers, and forming interdisciplinary review teams to ensure precise paper evaluations.

Keywords: Academic novelty; Academic attention; Academic impact; Excellence Action Plan for China STM Journals

Author Contributions:
Li Ning: Conceptualized the framework, collected and analyzed data, wrote and revised the manuscript;
Jia Zejun: Supervised and revised the manuscript;
Wu Jian: Supervised topic selection and conceptualized the framework.

In 2019, seven ministries and commissions including the China Association for Science and Technology and the Ministry of Finance jointly launched the Excellence Action Plan for China STM Journals (hereinafter referred to as the "Excellence Action Plan"). The plan established seven sub-projects including leading journals and key journals, representing the most extensive, best-funded, and largest-scale specialized support program for scientific journals in China, aimed at promoting high-quality development of Chinese STM journals and building world-class publications. As 2023 marked the conclusion of the first phase of the Excellence Action Plan, evaluating the achievements of scientific

journals and exploring their role in leading development and breakthrough innovations can provide theoretical reference for the new round of the plan.

Innovation serves as the source of sustainable development for scientific journals and the core driving force for continuously advancing the frontiers of scientific knowledge, while also representing an important criterion for measuring the intrinsic value of research papers. With the development of theories and methods in scientometrics, evaluation criteria for research papers have become increasingly diverse, evolving from traditional peer review to citation-based evaluation [1], then to altmetrics evaluation using supplementary indicators such as comment counts, downloads, and bookmarks [2,3], and now moving toward novelty evaluation [4,5]. Accurately measuring the novelty level of research papers can not only stimulate researchers' enthusiasm and promote the output of high-quality innovative achievements, but also help further construct a scientific journal evaluation system based on innovation quality and contribution, thereby enhancing the recognition and discourse power of Chinese STM journals in the global academic community.

In recent years, scholars have conducted preliminary research on the scientometric evaluation of paper novelty. Current common novelty evaluations include: First, novelty evaluation based on combinatorial citations. Innovative ideas in scientific research may involve original or atypical combinations of existing theories, methods, or practices [6,7], thereby creating new insights, experimental designs, or research paradigms. Combinatorial citation-based novelty indicators can capture the interdisciplinary nature of research [8]. Uzzi et al. calculated novelty by counting specific journal pairs, using journals to represent different knowledge domains, and argued that a paper has higher novelty if it cites rarer journal combinations [7]. Wang et al., when measuring paper novelty, considered only previously unseen journal combinations in a paper's references as a tool for measuring novelty, rather than all possible journal combinations [9]. Uzzi et al.'s research revealed that innovative papers are more likely to become highly cited papers, i.e., high-impact papers [7], a result also confirmed by Chinese scholars using data from library and information science papers [10].

Second, novelty evaluation based on citation networks. Funk et al. quantified the degree to which patents disrupt current scientific paradigms by considering their forward citation and backward diffusion structures [11]. Subsequently, Wu et al. used citation networks to assess the disruptive innovation degree of papers and found a significant positive relationship between team size and paper disruptive innovation [5]. Liu and Liao constructed a journal disruptive transcendence index based on the disruptive innovation index of academic papers to measure journal novelty, proving that this indicator can effectively identify high-quality journals [12]. Jiang et al. evaluated the novelty of Chinese STM journals and found that disruptive innovation of journals is relatively consistent with expert peer review results [13]. Existing research has focused primarily on the disruptive innovation index, with insufficient attention to combinatorial novelty with interdisciplinary characteristics, and has not deeply explored the relationship be-

tween combinatorial novelty and both attention and impact. Based on this, this study uses papers published in leading and key journals under the Excellence Action Plan as data, quantifies paper novelty value using combinatorial novelty, and explores the relationship between academic novelty and both attention and impact in scientific journal papers, providing data support for understanding the role of novelty in academic dissemination.

1.1 Data Sources

Targeting the 22 leading journals and 29 key journals selected for the "Excellence Action Plan for China STM Journals," we downloaded all papers published after 2015 from these 51 journals using the Web of Science (WOS) database, limiting document types to "Article" and retrieving information including usage counts, citation frequency, reference counts, and funding. The retrieval date was June 6, 2024. Simultaneously, we obtained the impact factors and quartiles of the 51 journals from the Journal Citation Reports (JCR) database. After publication, usage counts and citations require time to accumulate. To ensure each paper had at least a complete three-year time window, we excluded papers published after 2020. Furthermore, since this study calculates the novelty degree of a journal pair based on its observed versus expected frequency over the past three years to evaluate paper novelty, the final sample consists of papers published in leading and key journals from 2018 to 2020.

1.2 Variable Selection

This study established dependent, independent, and control variables as follows:

(1) Dependent variables: Academic attention and academic impact.

Academic attention refers to the attention a paper receives, specifically measured by the number of times its full text is accessed or saved, which can be measured by usage counts. The WOS database usage count indicator includes: first, the number of times a record's full text is accessed or saved starting from February 1, 2013, which gradually increases or remains stable over time; second, the number of times accessed or saved within the most recent 180 days, which fluctuates as the end date of the fixed period advances [14]. The former is relatively stable and better reflects overall attention, while the latter only counts usage within the past 180 days and is more volatile. Therefore, this study selected the first usage count as the specific measure of academic attention.

Academic impact refers to the contribution and influence of a paper on the academic community, typically measured by citation counts.

(2) Independent variable: Academic novelty. Academic novelty refers to new viewpoints, ideas, methods, technologies, or theories proposed in research. Previous studies have shown that recombination of existing knowledge facilitates the creation of new ideas and perspectives [7]. Uzzi et al. calculated the difference between observed and expected frequencies of journal pairs in paper references, using the 10th percentile of reference journal pairs to measure pa-

per novelty. The expected frequency of journal pairs was obtained through a Monte Carlo algorithm variant that randomly switched citation relationships while preserving two key characteristics: the total citation count of papers and the temporal distribution of citations. Subsequently, Kim et al. extended Uzzi's novelty measurement using hypergeometric probability distribution [4]. This study draws on Kim's hypergeometric probability distribution to calculate novelty. Since smaller calculated novelty values indicate stronger novelty, this study takes the negative of the novelty value so that larger values indicate greater novelty.

(3) Control variables: Include author count, reference count, journal impact factor, funding, publication year, and research field.

Author count. Scientific collaboration has become the mainstream approach for conducting research and solving complex problems, representing an important driver of interdisciplinary collaborative innovation. Increased author count brings more knowledge to research, helps deepen study depth, and yields higher attention and impact [15].

Reference count. The number of references affects the number of possible journal pair combinations, thereby influencing paper novelty. Additionally, scholars have found a significant positive correlation between reference count and citation frequency [16].

Journal impact factor. The Matthew effect exists in academia [17]; high-impact-factor journals can continuously attract originally innovative manuscripts due to their broad influence and visibility. Meanwhile, papers published in these journals can achieve higher attention and impact.

Funding. Researchers receiving financial support from funding programs can purchase equipment, reagents, and pay for labor, facilitating more breakthrough research results and leading disciplinary frontiers [18]. Funding is a dummy variable: 1 indicates funding support, 0 indicates none.

Publication year. After publication, attention and impact require time to accumulate, so papers published in different years have varying attention and impact.

Research field. This study targets leading and key journals under the Excellence Action Plan, which belong to different research fields including neuroscience, optics, engineering, etc. Papers in these journals receive varying attention and impact. Therefore, this study classified journals into Life Sciences & Biomedicine, Physical Sciences, and Technology according to WOS research area standards [19]. Papers in Life Sciences & Biomedicine were coded as 0, Physical Sciences as 1, Technology as 2, and Multidisciplinary sciences as 3.

1.3 Statistical Analysis

SPSS 22.0 and Stata 16.0 software were used for statistical analysis. The Kolmogorov-Smirnov test was applied to analyze whether measurement data followed a normal distribution. For normally distributed data, results were expressed as (mean ± standard deviation) and independent samples t-test was

used for inter-group comparisons. For non-normally distributed data, results were expressed as Median (P25, P75) and Mann-Whitney U test was used for inter-group comparisons. Count data were described using count (%) and chi-square test was used for comparisons between two groups. Likelihood ratio tests were conducted to determine whether Poisson or negative binomial regression models should be used to analyze the relationship between academic novelty and attention/impact. Significance level was set at $\alpha = 0.05$.

2.1 Descriptive Statistics

The Kolmogorov-Smirnov test was used to examine the normality of academic impact, academic attention, academic novelty, author count, reference count, and journal impact factor. All six indicators failed normality tests ($P < 0.001$ for all). As shown in Table 1 , the descriptive statistics indicate 8,520 papers from leading journals and 10,758 from key journals. Leading journal papers showed higher academic impact, academic novelty, author count, and journal impact factor than key journal papers ($P < 0.001$ for all), lower reference count ($P < 0.001$), but no significant difference in academic attention ($Z = -0.913$, $P = 0.847$). The distributions of funding, publication year, and research field differed significantly between leading and key journal papers ($P < 0.001$ for all).

Table 1 Descriptive Statistics of Variables

Variable	Leading Journals (n=8520)	Key Journals (n=10758)	P-value
Academic Impact	18.0 (8.0, 39.0)	15.0 (8.0, 29.0)	<0.001
Academic Attention	29.0 (13.0, 66.0)	30.0 (14.0, 62.0)	0.847
Academic Novelty	-0.012 (-0.023, -0.004)	-0.013 (-0.025, -0.005)	<0.001
Author Count*	6.0 (4.0, 9.0)	5.0 (4.0, 7.0)	<0.001
Reference Count	39.0 (25.0, 51.8)	40.0 (31.0, 53.0)	<0.001
Journal Impact Factor	9.9 (6.1, 19.4)	7.6 (4.5, 10.9)	<0.001
Funding/Count (%)	1335 (15.67)	1169 (10.87)	<0.001
Publication Year/Count (%)	7185 (84.33)	9589 (89.13)	<0.001
Research Field/Count (%)			<0.001
Life Sciences & Biomedicine	2504 (29.39)	3232 (30.04)	
Physical Sciences	2625 (30.81)	3527 (32.79)	
Technology	3391 (39.80)	3999 (37.17)	
Multidisciplinary sciences	0 (0.00)	1269 (14.89)	

Note: Author count is missing for 3 papers in the leading journals group.

2.2 Regression Analysis

Before regression analysis, variance inflation factor (VIF) tests were conducted to examine multicollinearity among independent and control variables. The maximum VIF was 1.55, far below 5, indicating no serious multicollinearity. Since both academic attention and academic impact are count data, likelihood ratio tests were performed to determine whether Poisson or negative binomial regression models were appropriate. Results showed that the 95% confidence intervals for the overdispersion parameter alpha were (0.851, 0.892) and (0.845, 0.936), respectively, allowing rejection of the null hypothesis “alpha = 0” (cor-

responding to Poisson regression) at the 5% significance level. This indicates overdispersion, requiring negative binomial regression for both.

Table 2 Negative Binomial Regression Results of Academic Novelty on Attention and Impact

Variable	Model 1	Model 2	Model 3	Model 4
Academic Novelty	2.475*** (0.267)	1.361*** (0.256)	0.023*** (0.009)	0.010*** (0.001)
Author Count		0.033*** (0.002)		0.052*** (0.004)
Reference Count		0.547*** (0.032)		0.233*** (0.047)
Journal Impact Factor		-0.058*** (0.021)		-0.071*** (0.022)
Funding (Ref: No funding)		0.906*** (0.024)		0.271*** (0.039)
Publication Year (Ref: 2018)		0.730*** (0.029)		0.261*** (0.046)
Research Field (Ref: Life Sciences & Biomedicine)				
Physical Sciences		0.789*** (0.043)		0.789*** (0.043)
Technology				
Multidisciplinary sciences				
Constant				
Log-likelihood				

Note: Models 1 and 2 have academic attention as the dependent variable; Models 3 and 4 have academic impact as the dependent variable. Models 2 and 4 are missing 3 cases for author count. Standard errors are in parentheses; ** indicates P < 0.01, ** indicates P < 0.05.*

Table 2 shows that in Model 1, the regression coefficient for academic novelty is positive and significant at the 1% level. In Model 3, the coefficient for academic novelty is also positive and significant at the 1% level. After adding six control variables in Models 2 and 4, the coefficients for academic novelty decrease but remain positive and significant at the 1% level. These results indicate that higher academic novelty helps gain recognition from researchers, translating into citation behavior and thus more citations and greater impact. Increased academic novelty also helps raise paper usage counts and attention. For control variables,

Models 2 and 4 show that author count, reference count, and journal impact factor significantly promote both attention and impact. Funded papers have higher attention and impact than unfunded papers. Earlier publication years correlate with higher attention and impact, demonstrating the time accumulation effect. Physical sciences papers show higher attention and impact than those in life sciences & biomedicine, technology, and multidisciplinary fields.

2.3 Robustness Checks

To ensure reliability of regression results and conclusions, three robustness checks were performed. First, six indicators (academic attention, academic impact, academic novelty, author count, reference count, and journal impact factor) were log-transformed and analyzed using OLS regression. Second, academic novelty was converted to a dummy variable: papers with novelty values less than 0 were coded as 0, and those greater than 0 as 1. Third, to avoid influence from outliers, papers in the top 1% of attention and impact were excluded to examine the effect of academic novelty on attention and impact in the sample without outliers.

Table 3 Robustness Checks: OLS Regression, Novelty Dummy Variable, and Excluding 1% Outliers

Variable	OLS (Attention)	Dummy (Attention)	Exclude 1% (Attention)	OLS (Impact)	Dummy (Impact)	Exclude 1% (Impact)
Academic Novelty	1.615*** (0.326)	0.454*** (0.017)	0.434*** (0.015)	0.023*** (0.009)	0.010*** (0.001)	0.032*** (0.002)
Author Count	0.607*** (0.013)	0.225*** (0.020)	0.547*** (0.032)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Reference Count	0.706*** (0.013)	0.137*** (0.037)	0.618*** (0.015)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Journal Impact Factor	0.536*** (0.032)	0.126*** (0.021)	0.559*** (0.032)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Funding (Ref: No funding)	0.721*** (0.018)	0.851*** (0.017)	0.711*** (0.031)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Publication Year (Ref: 2018)	0.914*** (0.024)	0.710*** (0.029)	0.789*** (0.043)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)

Variable	OLS (Attention)	Dummy (Attention)	Exclude 1% (Attention)	OLS (Impact)	Dummy (Impact)	Exclude 1% (Impact)
Research Field (Ref: Life Sciences & Biomedicine)						
Physical Sciences	0.269*** (0.016)	0.360*** (0.017)	0.275*** (0.039)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Technology	0.251*** (0.039)	0.239*** (0.047)	0.248*** (0.046)	0.030*** (0.008)	0.010*** (0.001)	0.051*** (0.004)
Multidisciplinary sciences						
Constant						
Log-likelihood						

Note: Models 5, 6, and 7 have academic attention as the dependent variable; Models 8, 9, and 10 have academic impact as the dependent variable. Models 5, 6, 8, and 9 are missing 3 cases for author count. Standard errors are in parentheses; ** indicates P < 0.01, ** indicates P < 0.05.*

Robustness check results are shown in Table 3. Models 5, 6, and 7 show that regression coefficients for academic novelty on attention are all positive and significant at the 1% level, indicating that academic novelty significantly promotes attention. Models 8, 9, and 10 demonstrate that academic impact increases with novelty degree (P < 0.001 for all). These results confirm that the promoting effect of academic novelty on attention and impact persists when using OLS regression, converting novelty to a dummy variable, or excluding the top 1% of outliers.

3 Discussion

This study quantifies paper novelty value using scientometric theories and methods. By analyzing papers from leading and key journals under the Excellence Action Plan, we find that academic novelty plays an important role in enhancing both paper attention and impact.

First, academic novelty is an effective means to increase paper attention, as novelty degree significantly promotes usage counts. Papers with high novelty

value often receive special promotion from journals, such as featured placement on journal homepages and special columns, selection as cover papers with cover stories, sharing on social media platforms like Facebook and LinkedIn, email recommendations to subscribers, and presentation at academic conferences and seminars [20]. Through active journal exposure, innovative papers gain substantially increased readership and attention. Moreover, innovative contributions in research papers can inspire researchers and stimulate academic discussion and sharing. When researchers read an innovative paper, they may be inspired to propose new research questions, design new experimental methods, or develop new data analysis ideas. They typically share the paper actively within their research teams or on social media, engaging in exchanges and discussions with peers, thereby attracting more academic attention to the paper.

Second, academic novelty can effectively enhance paper impact. Specifically, higher novelty degree gains more recognition and citations, expanding academic influence. The value of academic novelty lies in advancing scientific frontiers, opening new fields, driving technological progress, and promoting the continuous evolution and deepening of the global knowledge system. Highly innovative research often proposes new theories, methods, or models, or integrates knowledge and methods from multiple disciplines to solve complex problems through interdisciplinary perspectives, advancing scientific knowledge and leading research frontiers. Therefore, innovative achievements more easily attract widespread attention and recognition from the academic community, thereby increasing their impact.

4 Recommendations

Academic novelty plays an important role in enhancing the international status of scientific journals. The following recommendations are proposed to improve international attention and impact of Chinese STM journals.

4.1 Assessing Global Research Trends to Plan Interdisciplinary Special Issues

Scientific journals should actively gather the exceptional wisdom of international editorial boards and deeply integrate the advantages of big data analytics and machine learning technologies to analyze and assess global research frontiers. Simultaneously, they should invite renowned scholars and field experts worldwide for discussions and consultations to identify the most promising interdisciplinary research topics. Based on these insights, journals should plan and launch interdisciplinary special columns, widely inviting experts from different disciplinary fields or with multidisciplinary backgrounds to contribute high-quality interdisciplinary innovative research, leading the direction of academic research, enhancing the international influence of scientific journals, and jointly promoting the prosperity and development of the global research ecosystem.

4.2 Enhancing Editorial Academic Sensitivity to Accurately Identify Innovative Papers

Academic novelty is a core factor in enhancing the international status and discourse authority of scientific journals, mainly including: "new theory—introducing new theoretical concepts rather than merely descriptive concepts; new mechanism—proposing new mechanisms within existing theoretical frameworks; new domain—transforming from Western cases to Chinese cases; new method—adopting new research methods; new data—using new data to 赋予研究新的意义" [20]. Therefore, enhancing editorial teams' sensitivity and judgment regarding academic novelty is crucial for promoting journal development. Regular editorial training should be organized, inviting top scholars in the field to share latest research findings and frontier theories to increase editors' understanding of academic hotspots and research trends. Meanwhile, interactive components such as case study analysis and simulated review exercises should be introduced to help editors learn how to identify innovation points in papers, understand their academic value, and select more original and forward-looking excellent achievements.

4.3 Forming Interdisciplinary Review Teams to Ensure Precise Paper Evaluation

With novelty evaluation as the orientation, recruit review experts with interdisciplinary backgrounds or scholars from other fields to form diversified review teams. Today, science is developing at an astonishing speed, driving technological iteration and promoting explosive growth of scientific knowledge. Innovation is a key element for scientific journals to gain academic recognition and enhance global academic discourse authority. Due to their complexity, interdisciplinary research often lacks unified evaluation standards. Introducing interdisciplinary review mechanisms and building diversified expert review teams with different disciplinary backgrounds ensures accurate assessment of interdisciplinary paper novelty, adapts to the special needs of interdisciplinary research, and helps enhance the academic reputation of scientific journals. For example, in 2022, the Proceedings of the National Academy of Sciences launched a Consultative Peer Review Pilot program that directly arranged peer review experts in advance for interdisciplinary projects with overly forward-looking perspectives, enabling interdisciplinary projects to be evaluated fairly and quickly by experts in the most relevant research fields.

5 Conclusion

This study examines the relationship between academic novelty and attention/impact using papers published in leading and key journals under the Excellence Action Plan. Empirical findings reveal a positive correlation between academic novelty and both attention and impact, demonstrating that academic novelty is not only an effective means to increase attention but also a key factor in enhancing impact. Therefore, we recommend assessing global

research trends to plan interdisciplinary special issues, enhancing editorial academic sensitivity to accurately identify innovative papers, and forming interdisciplinary review teams to ensure precise paper evaluation. This study focuses on combinatorial novelty with interdisciplinary characteristics and does not explore its differences from disruptive innovation indicators. Future research could compare these two approaches to deepen understanding of academic novelty benefits and provide reference for scientific journals.

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