Postprint: A Study on the Citation and Social Attention Advantages of Open Peer Review Journal Articles

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Abstract

[Purpose/Significance] To investigate the impact of open peer review (OPR) on citations and social attention of journal papers.

[Method/Process] Descriptive statistics and paired-sample nonparametric test methods were employed to compare differences between OPR and non-OPR journals in terms of journal age, SCI age, country, publication cycle, open access, review transparency level, paper citations, and social attention indicators; to explore the influence of general journal characteristics on citation and social attention indicators of OPR journal papers; and to examine the correlation between citation and social attention indicators of OPR journal papers.

[Results/Conclusion] OPR journal papers have significant advantages in citations and social attention. Country has a significant impact on citation indicators, and publication cycle has significant effects on both citations and social attention. Citation and social attention indicators of OPR journal papers are significantly positively correlated.

Full Text

Preamble

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A Study on the Citation and Social Attention Advantages of Open Peer Review Journal Articles

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Abstract: *[Purpose/Significance]* This study investigates the impact of open peer review (OPR) on journal article citations and social attention. *[Method/Process]* Using descriptive statistics and paired-sample nonparametric tests, we compared OPR and non-OPR journals across multiple dimensions: journal age, SCI-indexed age, country of origin, publication cycle, open access status, peer review transparency level, and article citation and social attention metrics. We explored how general journal characteristics influence OPR journal article citations and social attention, and examined the correlation between citation and social attention metrics for OPR journal articles. *[Result/Conclusion]* OPR journal articles demonstrate significant advantages in both citation and social attention. Country of origin significantly affects citation metrics, while publication cycle significantly influences both citation and social attention metrics. Citation and social attention metrics for OPR journal articles are significantly positively correlated.

Keywords: open peer review; citation advantage; social attention advantage; journal evaluation
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Peer review has a history of over 350 years and remains the primary method for journal article selection. Since the launch of the world's first academic journal, *Philosophical Transactions of the Royal Society*, in 1665, peer review has gradually become an essential procedure in academic journal publishing. Anonymous review is the most common form of peer review and has long been considered a relatively fair evaluation model. However, with the rapid development of the internet and technology, the open access (OA) movement, and the advancement of open science, the limitations of traditional peer review have become increasingly apparent. Questions about its transparency, fairness, and standardization have emerged, giving rise to open peer review. Open peer review (OPR) is a term proposed in contrast to closed peer review, based on the principles of open science. Its defining characteristic lies in varying degrees of openness and transparency. Although still an immature model with no unified definition, both domestic and international academic and publishing communities have actively explored its implementation. Whether OPR journals possess advantages in academic and social impact remains under-investigated through empirical research.

1. Research Status

Domestic and international research on OPR is generally limited, focusing primarily on three areas: scholar attitudes and participant perceptions, the impact of OPR on reviewer behavior and quality, and OPR models and implementation strategies. Among these, studies on OPR models and cognitive surveys are more common, while empirical research on the academic impact and social

attention of OPR journals is scarce.

1.1. Surveys on OPR Acceptance and Adoption

From the perspective of scholar attitudes and participant cognition, Zhang Yixi analyzed the OPR practices of the international journal *Atmospheric Chemistry and Physics* and reports on Nature's OPR experiments, finding that reviewers participating in OPR showed low enthusiasm, uneven distribution of review comments, and significant disciplinary differences in comment volume related to whether reviews were signed. Du Xingye et al. surveyed Chinese scholars' acceptance of open peer review through questionnaires, finding that half of Chinese scholars accepted OPR, though acceptance varied across disciplines and review stages.

1.2. Impact of OPR on Review Behavior and Quality

Regarding the impact of OPR on reviewer behavior and review quality, a randomized trial by BMJ found that disclosing reviewer identities had no significant effect on review quality, publication recommendations, or review time, but significantly increased reviewer refusal rates. However, editors of the *British Journal of Psychiatry* conducted another randomized controlled trial measuring review quality, tone, publication recommendations, and time spent per review. Results showed that 76% of reviewers agreed to sign their reviews, and signed reviews were of higher quality, more polite, and took longer to complete, though they contained more "accept" recommendations. This experiment provided evidence for OPR feasibility but also revealed inherent limitations. More recently, G. Bravo et al. compared five Elsevier journals before and after OPR implementation, examining changes in expert review willingness, recommendation types, review time, and report tone. The study found that publishing peer review reports did not compromise review willingness, opinions, or time spent. Younger scholars and non-academic researchers were more willing to accept OPR and provide positive, objective recommendations. Male reviewers tended to write more constructive reports in OPR settings. These results indicate that OPR does not compromise the peer review process, at least when reviewers can protect their anonymity, providing important evidence for OPR feasibility and sustainability.

1.3. OPR Models and Implementation Strategies

In terms of OPR models and implementation strategies, Liu Jingjing surveyed foreign OA journals and identified three main models: structured peer review, post-publication peer review, and third-party independent peer review. Zhang Chunli et al. proposed three OPR categories: fully open, limited open, and partially open peer review. Zheng Xintian et al. summarized OPR models into four types: signed review, pre-publication record disclosure, online reviewer disclosure, and post-publication commentary. Peng Lin et al. categorized mainstream OPR models into three types (public commentary combined with traditional peer review, public review results, and published review letters) and, through

comparative analysis of 30 scientific journals, found that most were OA journals, 50% were biomedical journals, and 70% adopted the public review results model. They recommended optimizing traditional peer review while introducing OPR to improve comprehensive quality and impact. Chinese scholars have also conducted case studies of domestic and international OPR journals (e.g., eLife, PLoS ONE, PeerJ, *Acta Psychologica Sinica*) and OPR platforms (The Winnower, Publons, E-prints preprints), exploring different OPR models, implementation strategies, advantages, disadvantages, and implications for China's peer review system.

1.4. Research on Article Citation and Social Attention Advantages

Both open access and open peer review fall under the umbrella of open science practices. Chinese scholar Liu Guifeng et al. constructed an open science framework comprising open science policy, open access, open data, open resources, open peer review, and open educational resources. OPR represents open evaluation within open science, achieving public assessment of research output through various combinations of disclosure elements such as reviewer identity, review results, and review processes. According to the European open science training organization FOSTER's semantic construction, open science includes open access, open data, reproducible research, open evaluation, open science policy, and open science tools. Open evaluation encompasses both OPR and open metrics/impact (Altmetrics, bibliometrics, semantic metrics, webometrics). From this logical relationship, the citation and social attention advantages observed in OA papers may also exist in OPR journal articles.

1.4.1. Citation Advantages of OA Papers Since 2001, numerous studies using different methods (e.g., impact factor comparisons, within-journal comparisons) across many disciplines have demonstrated that OA papers have citation advantages over non-OA papers. For example, C. Hajjem et al. surveyed 14 million papers in hybrid OA journals and found that OA papers in the same journal received more citations. E. Archambault et al. found that OA citation advantages primarily stemmed from self-archiving and free availability on web pages other than journal websites, though some scholars argue that OA citation advantages result from early view and selection bias.

1.4.2. Social Attention Advantages of OA Papers In 2015, H. Alhoori et al. found that OA papers had social attention advantages, though these diminished after controlling for journal, publication year, and citation count. X. Wang et al., E. Adie, M. Teplitskiy et al., and K. Holmberg et al. respectively found OA advantages in specific social attention metrics, such as page views, readership, shares, Wikipedia citations, and online mentions, with variations across data sources and disciplines.

1.4.3. Citation Advantages of OPR Journal Articles B. Lutz et al. (2010) investigated the OPR journal *Atmospheric Chemistry and Physics*

(ACP) and found that papers published in ACP had higher citation counts than those rejected by ACP and published elsewhere. However, Q. Zong et al. noted that papers rejected by high-impact journals are typically submitted to lower-impact journals, suggesting that most ACP papers may have been previously rejected by more prestigious journals. Therefore, the citation advantages of OPR journals require further investigation. In 2020, Q. Zong et al. used propensity score matching to examine citation differences in Scopus for PeerJ articles published between 2013-2015, finding that articles with OPR histories received significantly more citations than those with closed peer review histories, suggesting that open peer review can increase citation counts.

Currently, numerous studies report citation advantages of OA papers, with limited research on social attention advantages. Research on citation advantages of OPR journal articles is extremely rare, and theoretical and empirical studies on social attention advantages of OPR journal articles are lacking.

2. Data Sources and Research Methods

The birth of the arXiv preprint server in 1991 accelerated OA publishing. Subsequently, foreign journals, particularly OA journals, explored various OPR models and combinations, including disclosing reviewer identities, publishing review reports, author responses and revision explanations, and enabling public commentary. BMC series medical journals gradually disclosed reviewer identities and published signed reviews; BMJ began disclosing reviewer names after evaluating randomized trial results. Since 2006, more journals have joined OPR, including *Biology Direct* (2006), eLife (2011), *The EMBO Journal* (2010), F1000Research (2012), PeerJ (2013), and *Nature Communications* (2016). Among these OPR journals, the majority are in medical and biological fields, primarily due to the influence of large OA publishers and landmark OA movement events. Therefore, this study focuses on OPR journals in medical and biological fields.

2.1. Selection of Experimental and Control Journal Samples

After searching Chinese and English literature databases, we collected over 60 papers explicitly mentioning OPR journal names, from which we identified and verified medical and biological journals implementing OPR. We compiled a list of 56 medical and biological OPR journals as our experimental group (Sample 1). Considering citation time windows, we selected articles published in 2016 as our research objects. To compare OPR and non-OPR journals, we matched samples by discipline and impact factor. For each experimental journal, we identified its discipline and 2016 impact factor from the JCR database, then selected the closest impact factor match from journals in the same discipline to form our control group (Sample 2), also comprising 56 journals. If an experimental journal belonged to multiple disciplines, we prioritized the discipline listed first in JCR. Samples 1 and 2 were matched one-to-one in sequence.

2.2. Indicator Selection and Data Acquisition

Using the Web of Science JCR database, we retrieved journal information including open access status, publication cycle, discipline, 2016 impact factor, and year first indexed by SCI. We searched PubMed for journal founding year and country information, and consulted journal websites for OPR disclosure elements. We used Altmetric.com to retrieve Altmetric Attention Scores (AAS) for experimental and control group articles as social attention metrics, and the NIH iCite database to retrieve Relative Citation Ratios (RCR). Both AAS and RCR were cumulatively summed by journal and averaged, yielding mean social attention scores and mean relative citation rates. Data were retrieved between February 28 and March 18, 2020.

2.3. Research Methods and Procedures

First, we conducted descriptive analysis of experimental and control group journals, comparing OPR and non-OPR journals across journal age, SCI-indexed age, country, publication cycle, and open access status, and defined and analyzed OPR transparency levels. Second, we used paired-sample nonparametric tests to examine significant differences in citation and social attention advantages between OPR and non-OPR journals. Third, we employed one-way ANOVA and hierarchical regression to test how OPR characteristics (journal age, SCI-indexed age, publication cycle type, country, transparency level) influence citation and social attention metrics. Fourth, we used Spearman correlation analysis to examine relationships among OPR journal age, SCI-indexed age, citation metrics, and social attention metrics.

3. Results

3.1. Comparison of Basic Characteristics Between OPR and Non-OPR Journals and OPR Transparency

3.1.1. Journal Age Distribution In our sample, OPR journals were founded between 1982 and 2013, with the most additions in 2001, 2000, and 2003. To compare age distributions, we grouped journals into 10-year segments . OPR journals were all under 40 years old, with 47 (83.93%) aged 11-20 years, 6 (10.71%) aged 1-10 years, 2 aged 21-30 years, and 1 aged 31-40 years. Non-OPR journals showed a more dispersed distribution: 26.79% aged 11-20 years, 28.57% aged 21-30 years, 14.29% aged 31-40 years, and 12.50% aged 41-50 years. Thus, most OPR journals are younger than non-OPR journals.

3.1.2. SCI-Indexed Age Distribution Based on SCI-indexed age, we segmented journals into 5-year intervals . OPR journals were primarily distributed in the 6-10 year (55.36%) and 11-15 year (26.79%) groups, while non-OPR journals concentrated in the 6-10 year (25.00%) and 21-25 year (37.50%) groups. Over one-third of non-OPR journals were indexed by SCI earlier than OPR journals.

3.1.3. Country Distribution OPR journals originated from five countries: the UK (48 journals, 85.71%), USA (4 journals, 7.14%), Canada, Switzerland, and Poland. Non-OPR journals came from 15 countries, with the UK (32.14%), USA (28.57%), Germany (10.71%), Netherlands (5.36%), and China (3.57%). OPR journals are concentrated in a few countries, while non-OPR journals have a broader global distribution .

3.1.4. Publication Cycle Distribution Our JCR database investigation revealed distinct patterns . Among OPR journals, 48 (85.71%) publish by article (appearing as one issue per year in JCR), 5 (8.93%) are monthly, and one each are weekly, biweekly, and quarterly. Most international medical and biological OPR journals adopt single-article online publishing, issuing each accepted manuscript individually in full-text databases. These electronic journals typically have volumes but no issues, with all annual articles belonging to one volume and receiving sequential page numbers.

In contrast, over one-third of non-OPR journals (33.93%) are monthly, nearly one-third (28.57%) are bimonthly, with others being semimonthly (1), quarterly (6), or publishing 8, 9, or 10 issues annually. Notably, only 6 non-OPR journals (10.71%) publish once yearly, nearly eight times lower than OPR journals.

3.1.5. Open Access Status JCR database searches revealed significant differences . Nearly all OPR journals are open access (98.21%), with only one non-OA journal. Conversely, most non-OPR journals are subscription-based (44 journals, 78.57%), with only 12 OA journals (21.43%).

3.1.6. OPR Transparency Levels Building on T. Ross-Hellauer et al.'s (2017) definition of "OPR models," we assessed transparency based on seven disclosure elements: (1) identity disclosure, (2) report disclosure, (3) participation openness, (4) interaction openness, (5) author response disclosure, (6) review process record disclosure, and (7) final version commentary disclosure. By examining each OPR journal's website, we evaluated transparency levels by the number of elements disclosed simultaneously . Among 56 OPR journals, 46 (82.14%) disclosed three elements, 5 (8.92%) disclosed two, 2 (3.57%) disclosed four, and 3 (5.36%) disclosed one.

3.2. Citation and Social Attention Advantages of OPR Journal Articles

Since experimental and control group RCR and AAS means were not normally distributed, we used paired-sample nonparametric tests. Descriptive statistics showed experimental group percentiles for both AAS and RCR exceeded control group values. Normality tests confirmed all four variables were skewed. Nonparametric test results showed p-values far below 0.0001, indicating significant differences between experimental and control groups for both RCR and AAS.

OPR journals demonstrate significant citation and altmetric advantages over non-OPR journals.

3.3. Influence of OPR Journal Characteristics on Citation and Social Attention Metrics

3.3.1. One-Way ANOVA Results Country, publication cycle, and OPR transparency significantly affected RCR values; only publication cycle significantly affected AAS. UK OPR journals had significantly lower RCR than other countries. Journals with regular publication cycles showed significantly higher RCR and AAS than those publishing by article. Higher transparency OPR journals had lower RCR than less transparent journals.

Journal age significantly affected AAS but not RCR. Journals under 19 years old had significantly higher AAS than older journals. Regular publication cycles also showed higher AAS. After controlling for journal age and country, publication cycle remained a significant factor .

3.3.2. Hierarchical Linear Regression Results For RCR , Model 1 included journal age, country, and transparency as controls, with country showing significant influence (β=0.322, P<0.05). Model 2 added publication cycle, after which country influence became non-significant. Journal age, country, and transparency explained 23.3% of RCR variance. After controlling for these variables, publication cycle significantly affected RCR (β=-0.473, P<0.05), adding 8.9% additional variance. OPR journals with regular publication cycles had higher RCR scores.

For AAS , Model 1 (journal age, country, transparency) showed no significant effects. In Model 2, publication cycle significantly influenced AAS (β=-0.557, P<0.01), adding 12.3% variance. Regular publication cycle OPR journals had higher AAS scores.

3.4. Correlations Among OPR Journal Age, Citation, and Social Attention Metrics

Spearman correlation analysis showed no correlation between journal age or SCI-indexed age with RCR or AAS. However, RCR and AAS were significantly positively correlated (r=0.692, P<0.01), and journal age was significantly correlated with SCI-indexed age (r=0.534, P<0.01).

4. Discussion

4.1. Comparison of Basic Characteristics Between OPR and Non-OPR Journals

OPR journals differ significantly from non-OPR journals in age, SCI-indexed age, country distribution, and publication cycle. OPR journals are younger on average $(17.16\$\pm4.93 years vs. 30.82\pm20.22 years) and have younger SCI -$

indexedages(10.73±4.09*yearsvs*.15.52±$6.32 years). OPR journals are concentrated in Europe and North America, particularly the UK due to the BMC series (34 journals, 60.71%). BMC pioneered OPR, beginning experimental evaluation in 1999 and launching numerous OA+OPR journals in 2001. Non-OPR journals are distributed across six continents.

In publication cycles, 85.71% of OPR journals publish once yearly (by article), compared to only 10.71% of non-OPR journals. Liu Yi and Wen Tingxiao's research on SSCI-indexed information science and library science journals found significant performance differences across publication cycles. Wang Lingfeng et al. noted that online journals publish by article, differing from traditional cycles and greatly accelerating publication speed, though irregularly.

Most OPR journals are OA, likely because OA publishers are open science advocates who adopt OPR to increase transparency and improve processes. While previous research focused on OPR models, few have defined and compared transparency levels. Zhang Tong deconstructed OPR processes into a multi-level modular system; He Ziyue et al. categorized OPR into pre-publication, post-publication, and evaluation-separation models; Meng Meiren et al. conceptually defined OPR openness across three dimensions (content, participation scope, timing) but avoided classification due to overlapping categories. This study assesses transparency by the number of disclosure elements, examining its influence on citation and altmetrics.

4.2. Citation and Social Attention Advantages of OPR Journals

Using RCR as our citation metric and AAS as our altmetric indicator, paired-sample nonparametric tests revealed that OPR journals have significant citation and social attention advantages over matched non-OPR journals in the same disciplines with similar impact factors. RCR, a field-normalized article-level metric from the NIH, is particularly suitable for evaluating medical and biological journal articles. When comparing groups matched by discipline and impact factor, traditional citation counts would be meaningless. Using RCR based on co-citation networks, we found OPR journal articles had significantly higher average RCR scores. L. Bornmann et al. found RCR's novel normalization method yields relative citation rates independent of journal rank and discipline, showing higher correlation with peer review indicators than previous field-normalized metrics. Our AAS comparison also found significantly higher scores for OPR journals.

4.3. Influence of OPR Journal Characteristics on Metrics

One-way ANOVA showed country, publication cycle, and transparency significantly affected RCR. UK OPR journals had significantly lower RCR, possibly because most UK OPR journals use irregular online publishing with large article volumes and weaker average citation impact. Other countries' OPR journals typically use traditional regular publishing with higher impact factors and citation

influence. After controlling for country, publication cycle remained significant.

For AAS, journal age and publication cycle showed significant effects. Younger journals had higher AAS, possibly because older OPR journals are more traditional and less active in social media promotion. Regular publication cycles also showed higher AAS. After controlling for age and country, publication cycle remained significant, indicating it is a crucial factor influencing OPR journal academic and social impact. Regularly published OPR journals attract more scholars and public attention.

4.4. Correlation Between OPR Citation and Social Attention Metrics

Correlation analysis showed significant positive correlation between OPR journals' RCR and AAS, consistent with previous findings. Song Liping and Liu Chunli et al. found significant positive correlation between citation counts and F1000 scores, and weak positive correlation with Mendeley metrics. Ding Zuoqi et al. found significant positive correlation between AAS and citation frequency for *The Lancet* and Altmetric.com Top 100 papers. Wu Pengmin et al. found strong correlation between Altmetrics and citations for 68 high-quality Nature-indexed journals. Our results suggest OPR journals have high academic and social impact, and when journal impact is high, Altmetrics correlate strongly with citations.

5. Conclusions

This study concludes: (1) OPR and non-OPR journals differ significantly in age, SCI-indexed age, country distribution, and publication cycle. OPR journals are younger, concentrated in Europe and North America, mostly use irregular single-article online publishing, and are predominantly OA. Transparency levels can be preliminarily assessed by the number of disclosed elements. (2) Country significantly affects OPR citation metrics but not social attention; publication cycle significantly affects both. (3) OPR journals have citation and social attention advantages. (4) OPR citation and social attention metrics are significantly positively correlated.

OPR models are diverse and difficult to comprehensively identify. For journals implementing OPR from inception, paired-sample tests controlling for confounding variables are persuasive. However, for journals transitioning from traditional to OPR, longitudinal comparisons would be more effective. The interaction effects between OPR and OA, and the pathways through which OPR influences citation and social attention metrics, require further exploration.

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Citation and Altmetric Advantage of Open Peer Review Journal Articles

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Abstract: *[Purpose/Significance]* This study explores the influence of open peer review (OPR) on journal article citations and social attention. *[Method/Process]* Using descriptive statistics and paired-sample nonparametric tests, we analyzed differences between OPR and non-OPR journals in journal age, SCI-indexed age, country, publication cycle, open access status, peer review transparency level, and article citation and social attention metrics. We examined how general journal characteristics influence OPR journal article citations and social attention, and tested correlations between OPR citation and social attention metrics. *[Result/Conclusion]* OPR journal articles show significant advantages in both citation and social attention. Country significantly influences citation metrics, while publication cycle significantly affects both citation and social attention. OPR journal article citations are significantly positively correlated with social attention metrics.

Keywords: open peer review; citation advantage; Altmetric advantage; journal evaluation

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