Modeling the Mechanism of Journal Preprint Policies: A Grounded Theory Analysis

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Abstract

Purpose To explore the operational mechanism of journal preprint policies, grasp the policy pathways for coordinated development between journals and preprints, promote organic linkage between academic journals and preprints, and provide a basis for journals to formulate relevant guiding normative policies. Method Employing the grounded theory method, this study conducted categorical induction and model construction on the preprint policies of 120 journals, sorted out their operational mechanism on authors' preprint academic communication behavior, and analyzed the interaction mechanisms among various modules. Results The study induced one "storyline," three scenarios (main categories), nine categories, and twenty-five concepts regarding the operational mechanism of journal preprint policies on authors' preprint communication behavior, and constructed an integrated "Policy-Scenario-Behavior" model of the operational mechanism of journal preprint policies. Conclusion It is recommended that journals, in formulating preprint policies, focus on: improving the policy environment to enhance authors' willingness to submit preprints; promoting collaborative services to cultivate authors' preprint behavior literacy; and advocating credible dissemination while clearly stipulating preprint dissemination responsibilities.

Full Text

Preamble

Constructing a Mechanism Model of Journal Preprint Policy: An Analysis Based on Grounded Theory

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Abstract

[**Purpose**] This study investigates the mechanism of journal preprint policies to understand the policy pathways for collaborative development between journals and preprints, promote organic linkage between academic journals and preprints, and provide a basis for journals to formulate relevant guidelines and normative policies. [**Methods**] Using grounded theory methodology, we conducted categorical induction and model construction based on preprint policies from 120 journals, systematically examined their mechanisms of action on authors' preprint communication behaviors, and analyzed the interaction mechanisms among various modules. [**Findings**] We identified one "story line," three scenarios (main categories), nine categories, and 25 concepts describing the mechanism by which journal preprint policies influence authors' communication behaviors, constructing an integrated "Policy-Scenario-Behavior" model of journal preprint policy mechanisms. [**Conclusions**] We recommend that journals focus on three aspects when formulating preprint policies: improving the policy environment to enhance authors' willingness to submit preprints; promoting collaborative services to cultivate authors' preprint literacy; and advocating credible dissemination by clearly defining preprint communication responsibilities.

Keywords: preprint; journal policy; grounded theory; preprint literacy
Classification Number: G250

Introduction

The 14th Five-Year Plan for National Economic and Social Development of the People' s Republic of China and the Long-Range Objectives Through the Year 2035 explicitly propose "building a high-end exchange platform for national scientific research papers and scientific and technological information" in Chapter 4 on strengthening national strategic scientific and technological capabilities [1]. The Law on Scientific and Technological Progress of the People' s Republic

of China, revised and adopted at the 32nd session of the Standing Committee of the 13th National People' s Congress, mentions for the first time in its safeguard measures "promoting open science" [2]. As important components and key elements of high-end exchange platforms, journals and preprints play a pivotal role in advancing open science. According to our team' s tracking and analysis, during 2016-2021, more than 10 new preprint platforms were established annually on average internationally, with 21 new platforms launched in 2017 alone. There are five preprint platforms with over one million papers and seven platforms with over 500,000 papers [3], demonstrating that preprints, as an important academic communication mode, have attracted widespread attention from researchers, and preprint platform construction is flourishing. Hurd predicted in 2000 that by 2020, academic journals and preprint platforms would constitute two important pillars of scholarly communication [4], a prediction that has undoubtedly been validated [5].

Unlike traditional scientific publishing models centered on journals, preprints provide researchers with a new model for rapidly disseminating research findings, ensuring researchers'network-based first-publication rights. However, while preprints are highly favored, their quality has been contested. Since preprints generally lack the rigorous peer review process of academic journals, the scientific rigor, authenticity, and safety of their content cannot be adequately guaranteed, leading to frequent misuse and abuse by scientific peers, news media, and the public. To address this thorny problem and improve the quality of academic exchange and knowledge dissemination, it is necessary to actively carry out research on the collaborative development of academic journals and preprints, explore journal preprint policies, grasp the policy pathways for collaborative development from a top-level design perspective, analyze key policy dimensions and content elements, promote organic linkage between academic journals and preprints, provide a basis for stakeholders to formulate relevant guidelines and normative policies, and offer valuable references for constructing high-end exchange platforms in the context of open science.

Many researchers have already focused on the critical issue of collaboration between journals and preprints. Internationally, Massey et al. evaluated the preprint publishing policies of the top 100 clinical journals by impact factor [6], Silva et al. investigated and assessed changes in preprint usage and policy formulation across 14 major scientific publishers [7], and Klebel et al. examined the clarity of preprint policies across 171 major interdisciplinary academic journals [8]. In China, Chen Xuefei et al. proposed recommendations on preprint policies from a journal perspective [9], Zhu Jiali et al. suggested that China' s preprint platform construction should emphasize the formulation and promotion of rights and interests policies for scientific journals [10], Liu Jingyu et al. proposed constructing a multi-level preprint policy system starting from scientific journals [11], and Lei Xue recommended accelerating the formulation of China' s preprint policies and their integrated development with scientific journals [12]. Existing studies have selected different journal groups to investigate preprint policies, systematically reviewed relevant policy changes, details, and integrated

development, and offered suggestions for journals to formulate preprint policies. Comparatively, international studies typically involve larger journal samples and focus on specific policy content, while Chinese studies emphasize surveys of representative policies and stakeholder needs. Overall, both domestic and international research lacks text analysis based on multidisciplinary top-tier journals' preprint policies and in-depth exploration of policy construction elements.

To address these research gaps and explore policy pathways for collaborative development between journals and preprints, while considering the representativeness and accessibility of research objects, this study uses the 2022 Journal Citation Reports Partition Table of the Chinese Academy of Sciences Library and Information Center (hereinafter referred to as the "Journal Partition Table") as the data source. Employing grounded theory methodology, we conducted text coding analysis and content mining on preprint policies from the top 120 journals to explore the mechanism model of their preprint policies, providing references for more journals domestically and internationally to formulate preprint policies and promoting collaborative development between journals and preprints in the open science era.

1 Research Methods and Design

Currently, formal academic exchange is determined by journal publication, and journals' attitudes toward preprint submissions directly influence authors' understanding and behaviors regarding preprint scholarly communication. The "journal preprint policy" referred to in this paper means the policies formulated by journals themselves regarding the handling of preprint manuscripts, provided for authors' reference during submission. Journal preprint policies generally explicitly state the journal' s attitude toward preprint manuscripts, processing methods, and authors' precautions during the preprint release and journal publication process.

1.1 Sample Source

The Journal Partition Table aims to evaluate the academic impact of SCI journals and can provide references for academic submissions and support for macro-level judgments by research management departments [13]. Accordingly, this study focuses on journal-level preprint policies and selects the top 120 journals from the Journal Partition Table as the research sample for preprint policy investigation.

Statistical analysis of the external characteristics of the sample journals reveals that in terms of geographical distribution, the United States and the United Kingdom have the most listed journals, with the U.S. ranking first with 58 journals (48.3%) and the U.K. having 51 journals (42.5%), while other countries lag significantly behind. Regarding disciplinary fields, according to the classification in the Journal Partition Table, medical journals account for the largest proportion at 48%, followed by biology at 13%, while physics and as-

trophysics, materials science, and other disciplines each account for less than 10%. In terms of publishers, the 120 journals involve 46 publishers (based on the Publisher field in JCR), with NATURE PORTFOLIO publishing the most at 33%, followed by Annual Reviews at 9% (see [Figure 1: see original paper]). Considering the development history of preprints, preprint scholarly communication emerged earlier in developed countries such as the U.S. and U.K., with the currently most influential preprint platform arXiv originating in the U.S. During the COVID-19 pandemic, the rapid publication demand for relevant papers in medicine, biology, and other fields was an important driver for the rapid popularity of preprints. International renowned publishers such as Nature have also paid early attention to the preprint scholarly communication model, with relatively complete preprint policy construction. Thus, the preprint policies of the selected sample journals can basically reflect the mainstream views of the current international cutting-edge academic community on the preprint scholarly communication model, are representative to a certain extent, and can provide exemplary samples for preprint policy construction for most scientific journals.

The investigation found that only 3 journals (2.5%) among the 120 had no preprint policy, indicating to some extent that preprints, as a new academic communication model, have attracted high attention from high-level scientific journals. Since some journals belong to the same publishing institution and their preprint policy content is extremely similar, the investigated preprint policies were selected, merged, and organized, resulting in 53 preprint-related policies from 35 different source journals ().

**** Sample Sources of Journal Preprint Policies

Policy Text Source	Specific Policies
Nature Research series (21 journals)	Preprints and Conference Proceedings
Nature Review series (18 journals)	News and Embargo Policies, Self-Archiving and Licensing, Preprint Policy, Reasons for Preprints, Preprint FAQ
Lancet series (8 journals)	Preprints
ScienceDirect series (11 journals)	Elsevier Supports Responsible Sharing, Preprint Server Policy
JAMA series (5 journals)	Previous Publications, Related Manuscripts and Reports, and Preprints
Cell Press series (10 journals)	Prior Publication and Preprint Posting
Science series (2 journals)	Science Journals: Editorial Policies, Preprint Servers
BMJ Publishing Group series (2 journals)	Preprints

Policy Text Source	Specific Policies
Annual Reviews series (9 journals)	Instructions for Preparing Manuscripts, Preprint Sharing
Springer Nature series (3 journals)	Self-Archiving Policy, Information for Authors, Submission Guidelines-Publication Policy
Oxford University Press series (4 journals)	Physiological Reviews, Psychological Bulletin
IEEE Communications Surveys and Tutorials	IEEE Article Sharing and Publication Policy
Acta Numerica	Cambridge University Press Preprint Policy
Clinical Microbiology Reviews	Preprint Policy
Circulation	Prior Publication Policy
Molecular Cancer	Wiley Preprint Policy
Reviews of Geophysics	Dual and Prior Publication Policy
Cancer Discovery	Taylor & Francis Editorial Policy
CA: A Cancer Journal for Clinicians	What are Preprints and Preprint Servers?
Advances in Physics	
Advances in Optics and Photonics	
Academy of Management Annals	Academy of Management Open Access
Review of Educational Research	
The American Journal of Psychiatry	Information for Contributors
Reviews of Modern Physics	
Journal of Clinical Oncology	
New England Journal of Medicine	
Journal of the American College of Cardiology	Author Instructions
Annals of Internal Medicine	
Chemical Reviews	
Chemical Society Reviews	Publication Process and Policy
Psychological Science in the Public Interest	APS Editorial Policy
European Journal of Psychology Applied to Legal Context	

1.2 Research Methods

This study primarily employs grounded theory to conduct categorical induction and model construction based on obtained journal preprint policies, systematically examining their mechanisms of action on authors' preprint scholarly communication behaviors and analyzing the interaction mechanisms among various modules. Grounded Theory (GT), proposed by American scholars Anselm

Strauss and Barney Glaser in 1967, is a qualitative research method that advocates developing theory from data rather than deducing verifiable hypotheses from existing theories [14]. The main steps of grounded theory include: (1) generating concepts from data through progressive coding; (2) continuously comparing data and concepts, systematically asking generative theoretical questions related to concepts; (3) developing theoretical concepts and establishing connections between them; (4) theoretical sampling and systematic data coding; and (5) constructing theory to achieve density, variation, and high integration of theoretical concepts [15]. Grounded theory is thus a bottom-up approach to building substantive theory. Since journal preprint policies have not yet reached consensus and each journal spontaneously formulates policies based on its own characteristics, grounded theory can be used to analyze and organize scattered, disordered preprint policy texts, thereby constructing a mechanism model of journal preprint policies to provide references for journal policy formulation.

Based on this, this study first conducts a preliminary investigation of the general situation of journal preprint policy construction, including external characteristics such as visibility and independence. It then delves into the specific content of preprint policies, conducting open coding, axial coding, and selective coding on original policy statements based on grounded theory to form a series of initial concepts, categories, and main categories, summarize typical structural relationships, construct a theoretical model, and conduct theoretical saturation testing. Finally, the model is analyzed in conjunction with policy text content, and policy formulation recommendations are proposed.

2 Results

2.1 External Characteristics of Preprint Policies

2.1.1 Independence Characteristics of Preprint Policies The independence of a journal' s preprint policy refers to whether its policy content is significantly distinct from other journals and whether it reflects the journal' s unique attitude or measures toward preprint scholarly communication. The investigation found that the independence of preprint policies is often influenced by the nature of the journal' s publishing institution. Based on the degree of policy independence, they can be roughly divided into three categories: First, journals in the same series follow a unified preprint policy, generally formulated by the parent publishing organization for direct reuse by journals. For example, the 39 journals in the Nature series in , though further subdivided into Nature Research and Nature Review series, all uniformly adopt the preprint policy updated by Springer Nature in 2019 [16] to better promote preprint scholarly communication. Second, journals formulate their own more suitable preprint policies while linking to parent or other preprint policies. These journals partially follow their parent publishing organization' s preprint policy but provide more detailed statements or explanations regarding the editorial office' s handling of preprint manuscripts. For instance, *Gastroenterology* declares that preprints cannot be updated during manuscript review or even after journal acceptance [17], while

its publisher Elsevier' s article sharing policy states that authors may update preprints on arXiv or RePEc with accepted manuscripts [18]. Third, journals independently formulate their own preprint policies, mainly because these journals are highly independent without sister journals or similar affiliated journals, though no special features were found in their policy content.

2.1.2 Visibility Characteristics of Preprint Policies The visibility of a journal' s preprint policy refers to its location within the journal' s overall policy system and how easily it can be accessed by authors. The investigation results show that the overall visibility of journal preprint policies is not optimistic. First, regarding the hierarchical level of website sections where preprint policies are located among the 53 policies, 18 (33.9%) were found under level-3 sections, 17 (32%) under level-2 sections, 8 each under level-4 and level-5 sections (15% each), only 1 policy appeared on the website homepage (Lancet series journals), and 1 policy was located under a level-7 section. Generally, the deeper the section level where the preprint policy text resides, the more time and effort authors must spend to find and understand the policy, and the more likely they are to commit behavioral misconduct due to inadequate understanding of the journal' s specific policy, thereby hindering preprint scholarly communication. Second, regarding the parent categories of preprint policies, except for the Lancet series journals which have a dedicated preprint section on their homepage, most journals categorize preprint policies under editorial policies (41.5%), author guidelines (32.0%), or publication policies (13.2%). Among the 53 preprint policies, only 4 (7.5%) are under open access policies. Given the characteristics of preprint scholarly communication, its open science attributes are evident, and the investigation found that some journals recommend the Sherpa/RoMEO platform for querying journal preprint policies. However, this platform actually primarily serves open access for journals, collecting and displaying open access policies from publishers and journals worldwide [19].

2.2 Policy Content Analysis

2.2.1 Open Coding This study obtained 628 original statements after segmenting and refining the raw textual materials, randomly selecting 2/3 for text coding and reserving the remaining 1/3 for theoretical saturation testing. Through open coding, we conceptualized codable statements or fragments sentence by sentence to obtain initial concepts and identify conceptual categories. Observation revealed that due to varying levels of journal understanding or support for preprint communication, preprint policies exhibit diversity, resulting in some initial concepts having opposite characteristics. For example, while most journals do not consider preprint posting as "prior publication" and state it will not affect manuscript consideration, some journals explicitly indicate they may incorporate "information redundancy" caused by preprint posting into their acceptance considerations. Therefore, we further integrated and refined initial concepts, ultimately obtaining 25 initial concepts (denoted as pn) through open coding.

We then merged these concepts based on their correlational and categorical relationships, determining their belonging categories through a combination of quantitative and qualitative methods. In practice, we focused on coded nodes with coverage rates below 1%, further merging similar concepts or deleting concepts to reduce redundancy. However, based on this study' s purpose, we retained individual initial concepts with unique functional roles. For example, "p22: Media responsibility for preprint reporting," though mentioned only in Nature Portfolio' s *Press and Embargo Policy* with a coding coverage of only 0.14%, was retained considering the completeness of the "P8: Preprint media reporting" category and the importance of media reporting for preprint scholarly communication. Ultimately, the 25 initial concepts were categorized into 8 categories (denoted as Pn). Examples of open coding are shown in .

**** Examples of Open Coding Categorization

Original Statements (Partial)	Initial Concept	Category
"As part of Nature Portfolio, Nature follows the common policies detailed in the left-hand menu that our authors and potential authors must follow."	p1: Following unified policy	P1: Policy coordination
"Please consult the journal' s submission guidelines to determine whether the journal will consider submissions previously shared as preprints. While SAGE generally supports preprints···some journals will not consider submissions that have been shared as preprints prior to submission."	p2: Policy cross-checking	
"For reasons of patient confidentiality, this policy does not apply to case reports. Therefore, BMJ will not accept case reports previously submitted to preprint servers."	p3: Policy applicability scope	
"BMJ fully supports and encourages archiving preprints in any recognized non-profit preprint server."	p4: Encouraging preprint communication	P2: Journal attitude

Original Statements (Partial)	Initial Concept	Category
"1) Annals of Internal Medicine will not automatically exclude manuscripts from publication consideration simply because authors posted them on preprint servers before journal submission for peer review. 2) Evaluation will involve determining whether final publication would add meaningful new information to the medical literature or would be redundant with information already disseminated at the time of preprint posting."	p5: Preprint manuscript processing	
"If preprints are essential to your work or cover key developments in topics addressed in your paper but have not been formally published, you may cite these preprints. Preprints should be clearly labeled, for example with [preprint] before references, and specifically referred to as preprints in the text."	p6: Allowing preprint citation	
"Preprints are papers made publicly available through community preprint servers before (or simultaneously with) submission to journals. Preprint servers, which allow papers to be posted before submission for publication, are becoming increasingly common across a range of disciplines."	p7: Definition of preprints	P3: Preprint details

Original Statements (Partial)	Initial Concept	Category
"What are the benefits of preprints? Visibility: The more places you can be discovered by peers and the public, the more you will be discovered. Preprints allow you to gain views and citations faster than traditional publishing routes; Research community: By choosing to post your article as a preprint, other researchers can discover your work faster, provide useful feedback, suggest new research or data to strengthen your arguments, and even recommend collaborations that will lead to follow-up research; Credit: By posting a citable preprint with its own unique DOI along with your research results, you can firmly claim the work you' ve done. Posting preprints allows researchers to publicly mark their discovery dates; Career development: Preprints allow you to showcase your work for funding, hiring, or tenure applications."	p8: Advantages of preprints	
"1) At The Lancet Group, preprints are primarily used for research purposes, similar to conference abstracts or presentations, and institutional internal discussions of research projects. 2) Preprints provided through SSRN (Social Science Research Network) are not Lancet publications and are not necessarily under consideration by Lancet journals."	p9: Positioning of preprints	
"Authors should disclose details of preprint posting, including DOI and license, when submitting manuscripts or at any other time during consideration by BMC (BioMed Central) journals."	p10: Article preprint status	P4: Submission disclosure requirements

Original Statements (Partial)	Initial Concept	Category
“We require authors to include one of the following symbols on the preprint cover: Submitted to Reviews of Modern Physics or Submitted to Reviews of Modern Physics.”	p11: Preprint submission status	
“ASM (American Society for Microbiology) also allows authors to deposit their submitted manuscripts directly from ASM’ s submission system to bioRxiv. This is entirely voluntary.”	p12: Preprint posting services	P5: Journal preprint services
“1) Springer Nature collaborates with Research Square to provide In Review, a journal-integrated preprint sharing solution that supports authors in all communities we serve to share their research early. Authors submitting to certain Springer Nature journals can also publicly share information about peer review through In Review. 2) APS (American Physiological Society) journals acknowledge the right but not the obligation to consider previous comments made on manuscripts posted to preprint servers during the peer review process.”	p13: Open review services	P6: Journal rights protection
“Preprints cannot be updated during manuscript review, nor can they be updated if the journal accepts them for publication, even if the preprint server instructs authors not to do so.”	p14: Peer review restrictions	

Original Statements (Partial)	Initial Concept	Category
"1) Once the preprint is published, authors are responsible for ensuring the preprint record is updated with publication references, including the DOI and URL link to the published version on the journal website. 2) As part of the AGU (American Geophysical Union) journal submission process, papers submitted to Earth and Space Science Open Archive will be automatically updated with links to the final published article, requiring no action from authors."	p15: Formal publication version	
"Authors may choose any license for preprints, including Creative Commons licenses. The type of CC license chosen will affect how the preprint is shared and reused."	p16: Free choice of knowledge sharing license	P7: Preprint operations
"Authors choosing to post work on preprint servers should select servers that clearly identify preprints as not peer-reviewed works, including author conflict of interest disclosures, have comment mechanisms, evaluate whether works meet basic ethical standards before posting preprints, and have mechanisms for identifying published articles related to preprints."	p17: Prioritizing recognized servers	
"1) Before agreeing to publicly post manuscripts on SSRN, corresponding authors should seek approval from all co-authors. 2) Preprints should not be added to or enhanced in any way to make them appear more like or as substitutes for the final article version."	p18: Informed preprint posting	
"5. Do we allow paper revisions? No, only the originally submitted paper will be posted. Revisions are only allowed when significant errors are discovered."	p19: No arbitrary withdrawal or modification	

Original Statements (Partial)	Initial Concept	Category
"Authors should not transfer copyright during the preprint process; authors should retain copyright in their work when posting to preprint servers."	p20: Author copyright retention	
"Authors should recognize that disseminating research as preprints may affect the priority order of subsequent publication."	p21: Impact of media reporting on journal publication interest	P8: Media reporting
"We also recommend that journalists reporting on preprints clearly state that the research has not been peer-reviewed and that findings may change."	p22: Media responsibility for preprint reporting	
"Authors posting preprints need to comply with our policies on communication with the media."	p23: Compliance with journal media embargo policies	
"Researchers may respond to media requests for preprints or conference reports by providing explanations or clarifications of the work, or information about its context."	p24: Preprint explanation or clarification	P9: Author obligations
"1) Science journals do allow posting of research paper submission versions on preprint servers, but these should not be discussed with the media. 2) We believe it is important that when works are discussed in public media, peer-reviewed and published paper versions should be provided so that media can provide informed commentary based on that version. For this reason, we strongly discourage soliciting media coverage before the final version of the paper is published."	p25: Preprint discussion restrictions	

2.2.2 Axial Coding Axial coding can reveal potential logical connections between categories and develop main categories and their subcategories. Based on the interrelationships among categories at the conceptual level and combined with the logical sequence of preprint manuscript circulation in the scholarly communication system, this study categorized them into three main categories. The main categories and their corresponding open coding categories are shown in .

**** Main Categories Formed Through Axial Coding

Main Category	Corresponding Open Coding Categories	Connotation of Relationship Structure
Preprint submission environment	P1 Policy coordination, P2 Journal attitude	Whether preprint policies are unified and whether their applicability scope is clear will affect the preprint submission environment
Preprint manuscript processing	P3 Preprint details, P4 Submission disclosure requirements, P5 Journal preprint services, P6 Journal rights protection, P7 Preprint operations	Detailed explanations of preprints, journal submission disclosure requirements, preprint services provided by journals, and rights protection measures will affect preprint manuscript processing
Credible preprint dissemination	P8 Media reporting, P9 Author obligations	Pre-publication dissemination and media responsibilities for preprint reporting, as well as authors' compliance with media embargo policies and obligations to explain, clarify, or discuss preprints, can promote credible preprint dissemination

2.2.3 Selective Coding Selective coding involves excavating the core category from main categories, analyzing the connection relationships between the core category and main categories and other categories, and depicting behavioral phenomena and contextual conditions through a "story line." After completing the "story line," a new substantive theoretical framework is essentially developed [20]. In this study, the typical relationship structures of main categories are shown in .

**** Typical Relationship Structures of Main Categories

Typical Relationship Structure	Connotation of Relationship Structure
Policy → Behavior	Journal preprint policies have important guiding effects on authors' preprint communication behaviors, directly guiding authors' handling of preprint manuscripts and influencing researchers' understanding of preprint scholarly communication

Typical Relationship Structure	Connotation of Relationship Structure
Policy environment → Preprint submission willingness	The preprint submission environment is the pre-stage scenario of authors' preprint communication behavior; the preprint policy environment created by journals affects the intensity and direction of authors' preprint submission willingness through this scenario
Collaborative service policy → Preprint behavior literacy	Preprint manuscript processing is the mid-stage scenario of authors' preprint communication behavior; journals' collaborative service policies for preprints affect the intensity and direction of authors' preprint behavior literacy through this scenario
Credible dissemination policy → Preprint communication responsibility	Credible preprint dissemination is the post-stage scenario of authors' preprint communication behavior; journals' credible dissemination policies for preprints affect the intensity and direction of authors' preprint communication responsibility through this scenario

In this study, we identified the core category of "the mechanism of journal policy' s effect on authors' preprint communication behavior." The "story line" around this core category can be summarized as: Journal preprint policies focus on regulating author behavior and have significant guiding effects on authors' preprint communication behavior; various scenarios throughout the preprint submission process—namely, the three main categories of preprint submission environment, preprint manuscript processing, and credible preprint dissemination—serve as important vehicles for journal policies to regulate authors' preprint communication behavior. Based on this "story line," this paper gradually organized and constructed a mechanism model of journal policy' s effect on authors' preprint communication behavior, namely the integrated "Policy-Scenario-Behavior" model, shown in [Figure 2: see original paper].

[Figure 2: see original paper] The Integrated "Policy-Scenario-Behavior" Model

2.2.4 Theoretical Saturation Test To ensure the saturation of concepts and categories obtained through the coding process, we conducted the same coding analysis and extraction process on the remaining 1/3 of original textual materials. No new categories or concepts were discovered, and no important relationships were omitted, leading us to infer that this theoretical model has

reached saturation and can effectively be used to explore the mechanism by which journal preprint policies affect authors' preprint communication behavior.

3 Discussion and Recommendations

The above analysis demonstrates that the integrated "Policy-Scenario-Behavior" model can effectively explain the formation mechanism of journal preprint policy effects. Specifically, the guiding role of journal policies on author behavior follows the logical sequence of the three main categories, namely relying on three scenarios—preprint submission environment, preprint manuscript processing, and credible preprint dissemination—to function. However, within different main categories, the mechanisms of policy effects on authors' preprint communication behavior (i.e., the ways and paths through which they influence author behavior) are not entirely identical.

3.1 Mechanism Analysis

3.1.1 Pre-submission Scenario: Preprint Submission Environment In authors' preprint scholarly communication, the preprint submission environment is the pre-stage scenario, determined by the journal' s overall preprint policy and reflecting the journal' s attitude and response measures toward preprint scholarly communication. The journal' s preprint policy environment includes two aspects: inter-policy coordination and the journal' s declared attitude toward preprint manuscript processing. Our findings indicate that: (1) Good coordination among policies is a prerequisite for creating a sound preprint policy environment. The current main approach to policy coordination is declaring adherence to unified preprint policies of the same series or parent publishing organization, while reminding authors to conduct policy cross-checking to prevent behavioral misconduct caused by policy differences between journals. Additionally, medical journals, considering patient privacy protection, remind authors to note the applicability scope of preprint policies, such as BMJ Publishing Group not accepting case reports previously posted on preprint servers [21]. (2) Journals can declare their attitudes toward preprint manuscripts from three aspects: first, whether they encourage or support preprint communication and recognize the enormous value of this communication form; second, the editorial office' s handling of preprint manuscripts—currently most journals state that posting preprints will not affect editorial consideration, though some medical journals may consider information redundancy caused by preprint posting [22]; and third, whether preprint citation is allowed, representing the journal' s view of preprint research findings. A positive journal attitude can effectively dispel authors' concerns about preprint scholarly communication, thereby positively influencing their preprint submission willingness.

3.1.2 Mid-stage Scenario: Preprint Manuscript Processing If a journal has a sound and permissive preprint submission environment, authors' manuscripts will smoothly enter the mid-stage scenario of preprint scholarly

communication—preprint manuscript processing. Currently, collaborative service content in journal preprint policies can be divided into three stages according to the manuscript processing workflow: (1) Before submission, journals provide detailed preprint explanations and operational norms prompts. Detailed preprint explanations mainly include definitions of preprints and preprint servers (platforms), advantages of preprints, and the positioning of preprints in the journal, including functional positioning and attribution positioning. For example, *The Lancet* states that preprints are primarily used for research purposes and that preprints provided through SSRN are not Lancet publications nor necessarily under Lancet review [23]. Regarding operational norms, most journals recommend that authors prioritize recognized servers, obtain informed consent from all authors when posting preprints, and retain copyright in preprint articles to ensure effective transfer to the journal in the future. (2) During submission, journals require authors to disclose preprint information, including disclosing manuscript preprint status to the editorial office and declaring article submission status on preprint manuscripts. (3) After submission, journals provide preprint-related services and impose restrictions on author behavior to protect their own rights and interests. Currently, more journals are collaborating with preprint platforms to launch bidirectional "direct transfer" services between journals and preprint platforms, greatly facilitating authors' preprint scholarly communication. Additionally, journal-preprint platform collaboration can provide open review services that add greater value to scholarly communication by obtaining peer feedback more quickly. However, some journals state that editorial offices have the right but not the obligation to consider comments received on preprint servers [24]. Rights protection measures mainly include prohibiting authors from updating versions on preprint servers during peer review to protect journal copyright, while requiring authors to ensure that records on preprint platforms point to the journal' s formally published version after article publication to minimize preprint diversion of journal citations. Although assigning responsibility for updating formal versions to authors is currently mainstream practice, some journals with deep preprint platform cooperation differ—for example, AGU journals state that papers submitted to Earth and Space Science Open Archive will be automatically updated with links to the final published article, requiring no action from authors [25].

3.1.3 Post-stage Scenario: Credible Preprint Dissemination After manuscripts are posted to preprint platforms and submitted to journals according to various requirements and norms, they enter the post-stage scenario of preprint scholarly communication—credible preprint dissemination. In this scenario, media and authors are the two major responsible parties, and their disordered interaction introduces uncertainty to credible preprint dissemination. Investigation results show that journals' control over credible preprint dissemination is mainly achieved through requirements for author behavior. Regarding media reporting, journals only recommend that journalists reporting

on preprints clearly state that the research has not been peer-reviewed. By stating that media reporting may affect journal publication priority, journals remind authors to pay attention to preprint media coverage. Regarding author obligations, journals stipulate that authors need to comply with media embargo policies, may explain or clarify media coverage of preprint work by providing background information, but should not extensively discuss specific work content with the media. If discussion is necessary, the final published version should be provided to the media [26].

3.2 Policy Recommendations

3.2.1 Improve Policy Environment to Enhance Authors' Preprint Submission Willingness Journal preprint policies directly affect the preprint submission willingness of the journal' s target authors, making preprint policy the "gateway" for journals to join the preprint scholarly communication system. With their advantages of public welfare, timeliness, interactivity, and first-publication rights confirmation, preprints are rapidly gaining favor among authors. Internationally, first preprint posting of major findings is gradually becoming an academic trend. Journals without preprint policies should introduce them as soon as possible to declare their attitudes and views toward preprint manuscripts. Journals with existing preprint policies need to continuously update them according to preprint communication development trends and establish connections between preprint policies and other policies to create a sound policy environment that enhances authors' preprint submission willingness. On the other hand, with their characteristics of free and immediate openness, preprints have become an important infrastructure for open science. To better promote preprint scholarly communication, journals should also consider closely integrating preprint policies with open access policies to help authors understand preprint policies more quickly and conveniently while improving policy visibility.

3.2.2 Promote Collaborative Services to Cultivate Authors' Preprint Behavior Literacy Although journals and preprints are both important carriers of scholarly communication, under the current academic evaluation environment, especially for early-career researchers, journals have relatively greater discourse power. Compared with recommended practices suggested by preprint platforms, journal policy requirements more strongly influence authors' attitudes toward preprint scholarly communication and regulate their preprint behavior. Based on the above analysis, in the preprint manuscript processing scenario, besides providing collaborative services with preprint platforms, journals also assign more responsibilities to authors and impose certain restrictions on author behavior, some of which even contradict recommended practices of preprint platforms, such as restricting preprint version updates. This reflects the value positioning of journals distinct from preprint platforms in the preprint scholarly communication system. Leveraging their policy influence, journals can actively seek cooperation with preprint platforms during manuscript processing,

integrate journal demands into the explanation, requirements, and norms for preprint manuscript screening through collaborative services such as manuscript recommendation and processing, thereby subtly cultivating authors' preprint behavior literacy while aligning with preprint communication trends.

3.2.3 Advocate Credible Dissemination by Clearly Defining Preprint Communication Responsibilities Due to their openness and iterability, preprints may conflict with journals' media embargo policies, mainly reflected in authors' personal sharing and media' s partial reporting. On one hand, journal preprint policies can address the communication demands of both authors and media by timely and appropriately reminding and restricting corresponding communication responsibilities in preprint policies. On the other hand, journals need to advocate responsible academic sharing by combining their existing embargo policies and controlling preprint dissemination by defining the communication responsibilities of both media and authors. Additionally, journals should take measures to strengthen interactive dissemination with preprint platforms, promote credible preprint dissemination through journal authority, and thereby foster a favorable academic sharing atmosphere.

4 Conclusion

This study employs grounded theory methodology to identify one "story line," three scenarios (main categories), nine categories, and 25 concepts describing the mechanism by which journal preprint policies affect authors' preprint communication behavior. We analyzed the ways and paths through which journal preprint policy mechanisms function in different scenarios and constructed an integrated "Policy-Scenario-Behavior" model describing its internal mechanisms. At the theoretical level, relevant conclusions can provide references for designing questionnaires, evaluation scales, and interview outlines for subsequent surveys on journal readers' or authors' attitudes and needs regarding preprint policies. At the practical level, the constructed "Policy-Scenario-Behavior" integrated model can guide the content construction of journal preprint policies. The study' s limitations lie in that journal preprint policy-related texts are often embedded among other journal policies, showing weak independence and integrity while being highly dispersed, which may result in omissions during raw material collection. Additionally, coding errors due to the coder' s skill level and professional perspective may cause deviations between model construction and actual conditions. Future research can improve the mechanism model of journal preprint policies by further enriching research samples and improving research methods.

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Author Contributions

Liu Jingyi: Designed the research topic and ideas, wrote and revised the paper;
Yang Heng: Designed the paper framework and research ideas, analyzed data, wrote the paper;
Xiao Li: Conducted investigation, wrote the paper.

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