Theoretical Research on the Layout Model of Scientific Journals: Based on Discipline and Impact Dimensions

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Abstract

Purpose/Significance This study explores the theoretical model of scientific journal layout to provide references for the arrangement of scientific journals in China. Methods/Process Employing web-based investigation, scientometric analysis, and inductive methods, this study analyzes the disciplinary and impact structures of journal portfolios from internationally renowned publishing organizations, thereby abstracting and forming a theoretical model for scientific journal layout. Results/Conclusion The theoretical model of scientific journal layout constitutes a matrix featuring integrated management, extensive disciplinary coverage, clearly stratified impact hierarchies, and diverse journal types. The layout of China's scientific journals should concurrently emphasize differentiation across both disciplinary and impact dimensions; disciplines should pursue diversity while avoiding overlap, redundancy, and gaps, and impact should form a rationally structured echelon comprising high-end comprehensive 'leading journals,' 'backbone journals' targeting different objectives, and 'cornerstone journals' that fill existing voids, with improved manuscript transfer mechanisms to foster cluster development.

Full Text

Preamble

A Theoretical Study of Scientific Journal Layout Models: A Discipline and Influence Perspective

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Abstract: [Purpose/Significance] This study aims to explore the theoretical model of scientific journal layout and provide references for the layout of sci-

entific journals in China. [Methods/Procedure] Utilizing methods such as network research, scientometric analysis, and induction, this research analyzes the disciplinary and influential structures of internationally renowned publishing institutions to abstract and formulate a theoretical model of scientific journal layout. [Results/Conclusions] The theoretical model of scientific journal layout is a comprehensive matrix that integrates management, covers a wide range of disciplines, exhibits distinct levels of influence, and includes diverse journal types. The layout of scientific journals in China should simultaneously focus on differentiation across both disciplinary and influential dimensions. In terms of disciplines, it is essential to strive for diversity while avoiding overlap, redundancy, and gaps. Regarding influence, a rational hierarchical structure should be established, comprising high-end comprehensive "leading journals," targeted "key journals" focusing on specific objectives, and foundational "cornerstone journals" that fill gaps. Additionally, improving the manuscript transfer mechanism is necessary to facilitate cluster development.

Keywords: scientific journals; journal layout; journal clusters; journal structure

Journal layout refers to the scientific planning of the number and structure of journals across various disciplines and influence levels within a journal cluster, based on disciplinary development and national science and technology development strategies. A rational journal layout helps optimize the allocation of academic resources, promote intensive development [1], unleash structural competitiveness, and advance the construction of world-class scientific journals in China. In 2019, the "Opinions on Deepening Reform to Cultivate World-Class Scientific Journals" jointly issued by four ministries placed "optimizing layout" in the primary position, emphasizing the need to "systematically assess the development status of scientific journals, strengthen top-level design, and highlight development priorities." In 2021, the "Opinions on Promoting the Prosperous Development of Scientific Journals" again pointed out the need to "strengthen top-level design and systematic planning, promote effective resource allocation, and clarify the functional positioning of various scientific journals," explicitly proposing in the optimization of layout structure to "focus on resolving content homogenization issues and support existing scientific journals in reasonably adjusting their positioning," gradually forming a "scientific journal publishing pattern with moderate total volume, dynamic adjustment, highlighted priorities, and rational structure." Evidently, journal layout is a critical bottleneck issue that urgently needs to be addressed in China's current process of building world-class scientific journals.

Existing research on journal layout can be categorized into two types: The first type involves deducing journal layout models based on structural theory. For instance, Zhang Lei et al. [2] proposed a "pyramid" model for journal layout from the perspective of journal functional positioning, arguing that functional levels determine a journal's height and development path. Tang Hongbo et al. [3] divided scientific journals into three journal groups performing differ-

ent social functions based on ecological theory. The second type summarizes journal layout models from domestic and international practices. For example, Shi Yunqing [4] introduced the "one core, multiple layers, collaborative development" cluster model of academic journals by the Chinese Mechanical Engineering Society; Zhang Ying et al. [5] described the four-tier journal cluster built by Light Academic Publishing Center through differentiated journal positioning; Liu Bing et al. [6] introduced the four "unified" model in management and operation shaped by the Chinese Medical Association Publishing House; Zhao Shaofei [7] investigated the journal cluster model of the Royal Society of Chemistry and summarized its advanced measures in journal incubation and operation management; Zhang Wei et al. [8] revealed model differences between Chinese scientific journal layouts and those of internationally renowned publishing institutions through comparative analysis. The first type lacks practical support, and its applicability has not been verified; the second type is either limited to a single discipline or publishing institution or focuses on journal management and operation. Both types lack research centered on the core elements of scientific journal content construction—discipline and influence—and based on the practices of multiple world-class publishing groups.

This study focuses on the two dimensions of discipline and influence of scientific journals, analyzes the layout structures of world-class publishing institutions based on data, summarizes their common characteristics, and distills a theoretical model of scientific journal layout to provide recommendations for China's scientific journal layout.

1. Research Objects and Methods

1.1 Selection of Research Objects

China's scientific journal cluster models can be divided into four types: those relying on publishing units, management, network platforms, and content [9]. Numerous existing studies have focused on the first three models. This study concentrates on the content-based cluster model. The "disciplinary journal cluster" is a typical model relying on professional content, aiming to gather journals in the same discipline to leverage cluster synergies, with a representative example being the "Chinese Medical Association Journal Cluster" [10]. This study selects several typical world-class publishing institutions as research objects, including multidisciplinary comprehensive publishers and discipline-specific professional publishers, to investigate and analyze their disciplinary and influence distribution patterns.

(1) Multidisciplinary Comprehensive Publishing Institutions

Nature Publication Group (NPG), as a core brand of the internationally renowned publishing group Springer Nature Group, publishes numerous world-class scientific journals including *Nature* and *Nature Communications*. NPG is a typical multidisciplinary publisher with high visibility and influence, possessing a global publishing network covering natural sciences, medicine, life

sciences, chemistry, and other fields [11]. NPG has become one of the most famous and authoritative journal clusters worldwide, with exceptional academic reputation and influence. NPG is rooted in the establishment and development of the journal *Nature*. Founded in 1869, *Nature* has evolved for over 150 years, gradually deriving a journal cluster with broad disciplinary coverage and clear hierarchical levels around *Nature*, possessing obvious advantages in external attraction and internal flow of manuscript sources. The establishment and development of NPG has undergone a long evolutionary process, forming a stable and organic layout structure, making its layout highly valuable for reference.

(2) Discipline-Specific Professional Publishing Institutions

Academic societies are typical discipline-specific professional publishers. According to statistics from the Journal Citation Reports (2022) of the National Science Library, Chinese Academy of Sciences, the list of international society publishers is as follows, where the columns for Zones 1, 2, 3, 4, and Total correspond to the number of journals in each zone. The average number of articles per journal represents the average publication volume of the publisher's journals from 2020–2021. Journal evaluation has two dimensions: influence and scale, where zone represents influence and average articles per journal represents scale. Here, publishers are sorted in descending order by the number of Zone 1 journals, and the top six publishers are selected while excluding those with low publication volumes. The American Chemical Society, American Medical Association, Royal Society of Chemistry, American Geophysical Union, and American Physical Society are initially selected as research objects. Considering the disciplinary overlap between the American Chemical Society and the Royal Society of Chemistry, the latter is further excluded, retaining the American Chemical Society to form the final research objects.

Zone Distribution and Average Publication Volume of Society Publishers

The American Geophysical Union (AGU) [12] is a non-profit professional scientific organization with 60,000 members in 137 countries. AGU publishes 19 academic journals, including the renowned *Journal of Geophysical Research* (JGR) series, covering atmospheric science, oceanography, space science, earth science, planetary research, and other fields. The American Medical Association (AMA) [13] is one of the three major medical associations worldwide, holding a high position in the medical field. Its comprehensive clinical medical journal *JAMA—The Journal of the American Medical Association* is internationally recognized as one of the four major medical journals. The American Physical Society (APS) [14] is one of the most prestigious professional physics societies globally, whose *Physical Review* series has expanded to 16 journals, most of which are high-quality and high-impact, covering major disciplinary categories in physics. The American Chemical Society (ACS) [15] is one of the largest scientific organizations in the world, with over 155,000 members in 150 countries/regions. ACS Publications is a globally renowned academic publisher and the largest society publisher, with substantial publication volume and rich types,

having published over 1.3 million research articles, 35,000 book chapters, and 1,000 guidelines and standards.

Overall, the selected publishing institutions have long-term publishing practices, have established journal clusters of considerable scale, and have exerted widespread influence worldwide. AGU, AMA, APS, and ACS are professional societies in different fields, representing disciplinary structural characteristics of journals in different domains, while NPG represents multidisciplinary comprehensive publishers. A comprehensive consideration of the journal disciplinary structures of both discipline-specific professional publishers and high-quality multidisciplinary comprehensive publishers helps us analyze the general patterns of world-class scientific journal layout and derive the theoretical model of scientific journal layout.

1.2 Research Methods

(1) Network Research Method: This study employs network research to collect and analyze basic data on the journal layout of publishing institutions.

(2) Scientometric Analysis Method: To quantitatively analyze the layout characteristics of research objects in terms of discipline and influence, this study collects paper and citation data from each publishing institution over the past five years and adopts scientometric indicators to further quantify the characteristics of their journal layout. This study involves two main measurements: journal disciplinary diversity and journal influence.

Regarding journal disciplinary diversity, to ensure comparability of journal disciplines across publishing institutions, this study utilizes a paper-level disciplinary classification system [16] and employs the Extended Gini indicator to calculate disciplinary diversity. The calculation formula is as follows:

where xi represents the ith topic of the journal, and N is the total number of research topics of the journal. The Extended Gini indicator considers both the diversity of journal disciplinary coverage and disciplinary balance [17].

For influence measurement, this study draws on the Citation Success Indicator (CSI) from the Journal Citation Reports [18][19]. The CSI from the Chinese Academy of Sciences' Journal Citation Reports is calculated based on topics from the paper-level classification system, focusing on the distribution of paper citations. Compared with the impact factor, it can reflect the internal citation distribution of a journal. The calculation method for journal A's Citation Success Index is as follows:

, representing the set of papers in journal A with topic t, where t topic1, topic2, topic3, …, and type d {article, review}.

(3) Induction Method: Based on the investigation and quantitative analysis of the journal layout of research objects, this study summarizes the commonalities and patterns of journal layout in internationally renowned publishing

institutions and abstracts them into a theoretical model of scientific journal layout.

2. Journal Layout Analysis

2.1 NPG Journal Layout Pattern

According to the Nature website [20], the NPG journal cluster consists mainly of four parts: (1) *Nature* itself and *Nature*-branded research journals, totaling 37 journals; (2) *Nature Review* series review journals, totaling 24 journals; (3) 8 Communications series journals; and (4) 4 other types, such as *Scientific Reports*. To further quantitatively investigate the disciplinary and influence structure of the NPG journal cluster, this study collected paper and citation data from NPG cluster journals over the past five years (2018–2022), selecting article and review types, and calculated each journal's influence and disciplinary diversity using the CSI indicator for influence and the Extended Gini indicator for disciplinary diversity. The layout of NPG journals in terms of discipline and influence is shown in Figure 1 [Figure 1: see original paper], where each point represents a journal, the point size represents publication volume, and the box on the right shows comprehensive journals within the NPG cluster.

Based on Figure 1, in terms of disciplinary diversity, specialty journals and comprehensive journals are located on the left and right sides respectively, with comprehensive journals showing significantly stronger disciplinary diversity than specialty journals. Within specialty journals, disciplinary diversity is unevenly distributed: *Nature* specialty journals and *Nature Review* series journals [21] have disciplinary diversity mostly distributed between [20–100], while Communications specialty journals show stronger disciplinary diversity than the former two groups. Examining the influence hierarchy, *Nature* is the top-tier comprehensive journal in the entire cluster, demonstrating cluster leadership in both disciplinary diversity and influence. *Nature* specialty journals and *Nature Review* series journals rank just below *Nature* in influence, with more focused research directions and relatively weaker disciplinary diversity. *Nature Communications* belongs to the middle-tier comprehensive journals with strong disciplinary diversity. Communications specialty journals have influence second only to *Nature Communications*, with fewer journals but stronger disciplinary diversity. *Scientific Reports* sits at the bottom of the cluster, being the journal with the strongest diversity in the entire cluster.

Combining the introduction to the NPG journal cluster and Figure 1, the NPG journal layout exhibits a matrix structure with disciplinary diversity and influence hierarchy (see Figure 2 [Figure 2: see original paper]).

As shown in Figure 2, the overall influence of NPG is divided into a top-down hierarchical structure. The top layer is the cluster's "leader" journal, *Nature*, which functions to "lead" the entire cluster. Below are middle-tier journals including specialty journals and Review series journals responsible for the cluster's main content construction. The construction of NPG's "manuscript trans-

fer mechanism" enables effective circulation of articles attracted by top-tier journals that cannot be published due to volume or quality requirements [22]; therefore, middle-tier journals serve a "bridging" function for the entire cluster. The bottom layer is the mega-journal *Scientific Reports*, which serves a "gap-filling" function for the cluster. This mega-journal not only can receive articles from upper-tier journals but also expand content in blank disciplines through its broad disciplinary coverage. Meanwhile, journals in the same discipline and type also form small hierarchical structures through influence differences, effectively avoiding homogeneous competition.

Overall, NPG has built a multidisciplinary, multi-type, and multi-level journal cluster based on *Nature*. Through positioning differences in discipline and type (comprehensive vs. specialty journals), it has constructed a "strip-block" structure that maintains disciplinary diversity in the cluster. Through influence differences, the cluster forms a "matrix" structure with natural ecological levels. This layout not only effectively avoids excessive homogeneous competition at the disciplinary level but also enables journals in the same discipline and type to reduce homogeneous competition through influence differences, forming a benign and sustainable internal cooperation mechanism through "manuscript circulation."

2.2 Journal Layout of Discipline-Specific Publishing Institutions

(1) Investigation of Discipline-Specific Journal Clusters

According to the AGU website, AGU publishes 19 academic journals, including two top-tier comprehensive journals in the field: the review journal *Reviews of Geophysics* and the letters journal *Geophysical Research Letters*. Professional journals include two main series: the *Journal of Geophysical Research* series and specialty series journals such as *Space Weather*. The AMA website publishes 12 medical journals, with *JAMA—The Journal of the American Medical Association* being a comprehensive journal with ultra-high influence. The series incubated by *JAMA* focuses on different professional disciplines, while the OA journal *JAMA Network Open* has a broad research scope. ACS publishes nearly 60 publications divided into seven categories: analysis-related, application-related, biology-related, materials science and engineering-related, organic-inorganic-related, and physics-related. The ACS cluster has three comprehensive journals: *Chemical Reviews*, *JACS*, and *ACS Omega*. In terms of professional journals, it has formed the ACS specialty journal series and the *J. Phys. Chem.* series. APS publishes 16 physics journals, including four comprehensive journals (*Reviews of Modern Physics*, *Physical Review X*, *Physical Review Letters*, and *Physical Review Research*) and 12 professional series journals with different research focuses.

To further investigate the disciplinary and influence structures of discipline-specific professional publishers, this study collected paper and citation data from the past five years (2018–2022), selecting article and review types, and calculated

each journal's influence and disciplinary diversity using the CSI indicator for influence and the Extended Gini indicator for disciplinary diversity. Details are shown in the figure below, where each point represents a journal, point size represents publication volume, and the box on the right shows comprehensive journals.

Figure 3 [Figure 3: see original paper] shows the disciplinary diversity and influence hierarchy of journals from four publishing institutions. Comparing the four clusters, comprehensive journals (within the right boxes) show stronger disciplinary diversity than specialty journals. AGU journals' disciplinary diversity is mainly distributed in [5–30], AMA journals in [36–140], ACS journals in [20–170], and APS journals in [5–90]. Examining the influence hierarchy: *Reviews of Geophysics* is the highest-impact journal (0.91) in the AGU cluster; the comprehensive journal *Geophysical Research Letters* (GRL) has strong disciplinary diversity and overlaps with *Reviews of Geophysics*, but GRL publishes letter-type (short article) papers and has lower influence (0.63) than *Reviews of Geophysics* (0.91). *AGU Advances* is the lowest-impact comprehensive journal in the AGU cluster with relatively strong disciplinary diversity. Between *AGU Advances* and the two comprehensive journals are two series of specialty journals: the *JGR* series and the *Space Weather* series. In the AMA cluster, the high-impact comprehensive journal *JAMA* (0.94) and the bottom-tier comprehensive journal *JAMA Network Open* (0.75) show significantly stronger disciplinary diversity than specialty journals, which constitute the main content in various professional directions with influence levels between the two comprehensive journals. The ACS cluster has a large number of journals, with three comprehensive journals showing large influence differences: *Chemical Reviews* (0.97), *JACS* (0.83), and *ACS Omega* (0.47), with multiple specialty series journals formed between *JACS* and *ACS Omega*. The APS cluster has the top-tier comprehensive journal *Reviews of Modern Physics* (0.89) and two comprehensive journals with relatively close influence levels, *Physical Review X* (0.81) and *Physical Review Letters* (0.74). The bottom layer is the newly developed comprehensive journal *Physical Review Research*, with specialty journals in various professional fields in the middle, showing similar influence levels but large differences in disciplinary diversity.

(2) Analysis of Discipline-Specific Journal Layout Patterns

Based on the official website investigations of each professional cluster combined with the data analysis in (1), discipline-specific journal layouts, similar to the NPG model, exhibit a matrix structure with disciplinary diversity and hierarchical levels (see Figure 4 [Figure 4: see original paper]).

Comparing the journal layout characteristics of the four professional clusters, society journal layouts feature a matrix structure based on disciplinary coverage diversity and influence hierarchy. Specifically, the layouts of AGU and ACS are similar, with top-tier leading journals, middle-tier journals producing main content, and bottom-tier cornerstone journals that receive articles and supplement disciplinary gaps. The layouts of AMA and APS place greater emphasis

on division according to specific fields or specialties, with specialty journals as the main type, aiming to better serve specific fields or disciplines and provide targeted information and communication platforms.

3. Theoretical Model of Journal Layout

3.1 Model Proposal

Based on the above analysis, we can distill the following theoretical model of journal layout from the perspectives of discipline and influence:

The horizontal axis represents disciplinary breadth, while the vertical axis represents influence hierarchy. Disciplinary breadth generally refers to the quantification of a journal's research topic coverage range, and influence hierarchy represents the quantification of a journal's citation performance over a certain period. The internal structure presents a "matrix" formation that can be mainly divided into five parts: top-tier comprehensive journals are positioned at the uppermost level, specialty journals are arranged across different disciplines below, a certain number of comprehensive journals serve as "bridges" in the middle, series of specialty journals are formed further down, and the bottom layer consists of comprehensive journals with the widest disciplinary breadth serving as the "foundation" of the entire matrix.

3.2 Characteristics of the Theoretical Model of Journal Layout

(1) Diversity and Difference in Disciplinary Coverage

The journal group has appropriate disciplinary coverage that can comprehensively address academic exchanges in various disciplines. Comprehensive journals have the widest disciplinary coverage and serve systemic functions such as leading development and bridging gaps. Each specialty journal focuses on a limited disciplinary scope with relatively concentrated topic ranges compared to comprehensive journals. Specialty journals in various disciplines achieve multidisciplinary distribution through differentiated positioning of research content.

(2) Hierarchy and Overall Coordination of Influence

Each journal has a clear positioning with an obvious hierarchical structure in influence, providing appropriate survival and development space for different journals. The system includes not only the demonstration and leadership of top-tier journals but also a group of excellent journals targeting different "ecological niches" to consolidate the foundation, promoting effective internal flow of manuscript sources and smooth inter-layer journal interactions. Journals at the same level achieve differentiation through type and research content.

Horizontal differentiation is mainly reflected in the differentiation of journal research scopes. To avoid homogeneous competition within the cluster, each journal cluster has a clear development direction for its journals. Vertically,

journals at different levels have different main tasks. Head comprehensive journals are usually the most influential and well-known journals in the field, and their published articles and research results have important driving effects on the field's development, playing a "leading" role. Middle-level specialty journals are the core content of the journal cluster, covering a large amount of research results and academic information, and serving as an important source for scholars in the field to obtain the latest research progress. Bottom comprehensive journals are mainly responsible for "bridging" blank directions not covered by specialty journals.

This differentiated positioning, on the one hand, avoids internal homogeneous competition among cluster journals, and on the other hand, helps form cluster advantages and promotes the sustainable development of the journal system.

(3) High Integration

Integrated journal management represents a common feature of publishers and society publishers, characterized by unified planning and management of their journals, including planned development of new journals, expansion of the research scope of journal clusters, and the ability to allocate resources globally.

4. Strategies for Scientific Journal Layout

Based on the theoretical model of journal layout, layout development should simultaneously focus on differentiation in both discipline and influence.

4.1 A "Holistic Perspective" for Overall Layout Comprehensiveness and Diversification

At the national coordination level, a "holistic perspective" should be adopted to oversee the comprehensiveness and diversification of the overall journal layout. In terms of disciplinary coverage, guidance should be provided on journal topics based on actual disciplinary development and national needs, avoiding disciplinary overlap, redundancy, and gaps while considering interdisciplinary integration. In terms of journal types, coordinated development of journal groups with different functions should be planned, including research specialty journals, research comprehensive journals, and review journals, to avoid homogeneous competition. In terms of hierarchical structure, journals should be guided to position themselves rationally to form hierarchical echelons, including not only leading journals benchmarking against *Nature*, *Science*, and *PRL*, but also key journals focusing on different objectives and cornerstone journals filling gaps.

4.2 Building Differentiated Journal Clusters through Brand-Driven Derivation and Manuscript Transfer Mechanisms

At the cluster publishing entity level, brand-driven derivation should be used to build a "manuscript transfer mechanism" and form differentiated development clusters. First, build brand journals with high influence to accumulate

manuscript source advantages. Second, use brand journals as leaders to conduct disciplinary splitting and influence splitting downward to form derivative groups. Through the "manuscript transfer mechanism"—automatically transferring manuscripts from high-influence journals to lower-influence journals without repeated peer review—promote internal flow and circulation of manuscript sources and achieve intensive production factors. Finally, after forming intensive development within disciplines, integrate publishing resources across fields and regions to advance collectivization.

4.3 Forming Core Competitiveness by Relying on Disciplinary Foundations and Coordinating Academic Resources

At the individual journal level, core competitiveness should be formed by relying on disciplinary foundations and coordinating academic resources. Journal cluster construction relies on disciplines. First, establish a "long-term interaction" mechanism between journals and disciplinary experts, using journal influence, conferences, and special issues to attract talent through journals, while cultivating talent through journals via youth special issues, youth forums, and youth editorial boards to enhance the stickiness between journals and disciplinary talent. Second, journal content should be constructed differentially with highlighted hierarchy. Emphasis should be placed on journal column construction to lead disciplinary development. Journals should rely on clusters to build influence and on disciplines to construct core content, thereby feeding back into disciplinary construction and forming a virtuous cycle of interaction between disciplines and journals to build a high-quality academic communication platform.

This study proposes a theoretical model of scientific journal layout through empirical methods. The model is a matrix structure with integrated management, broad disciplinary coverage, distinct influence hierarchy, and rich journal types, providing a framework for development, construction, and research at the national, cluster, and individual journal levels. This study has limitations, and future work will be strengthened in two aspects: (1) Quantification of indicators for the theoretical model of scientific journal layout. Currently, the model only provides theoretical ideas for scientific journal layout, but a model with quantified indicators would be more operational and comparable in practical application. (2) This study discusses relevant issues based on selected research objects without conducting large-scale cluster analysis. Expanding the research scale is also an important next step.

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