

## Open Sharing and Collaborative Research in Open Access Journals: A Case Study of Literature Citing PLOS ONE (Postprint)

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### Abstract

[Purpose/Significance] From the perspective of open access journal articles, this study aims to reveal the characteristics of open sharing and collaborative behaviors, thereby promoting cross-institutional and cross-disciplinary collaboration among researchers and the practical development of the open sharing movement. [Method/Process] Taking the citing literature of the top 100 most-cited papers in PLoS ONE as the research object, this study primarily employs citation analysis and social network analysis to reveal the content characteristics and relational features of collaboration within the PLoS ONE citing literature network. [Results/Conclusion] The quantity and rate of open sharing collaboration outcomes based on PLoS ONE have increased year by year, with prominent multi-disciplinary and cross-institutional collaboration characteristics. Collaborative content focuses on natural science fields such as biology and environmental science, while research in social sciences and humanities/arts is relatively limited, though cross-disciplinary collaborative research does exist. The author collaboration network exhibits multi-center and weak-tie characteristics. The institutional collaboration network forms a model with research institutes and universities at its core, complemented by synergistic participation from government agencies and enterprises. The disciplinary collaboration network demonstrates environmental adaptability and disciplinary inclusiveness, with strong collaboration intensity and correlation among core disciplines.

### Full Text

#### Preamble

**Open Sharing Cooperation Research from the Perspective of Open Access Journals: A Case Study of Citing Papers in *PLoS ONE***

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**Abstract:** *[Purpose/Significance]* This paper reveals the characteristics of open sharing cooperation behaviors from the perspective of open access journal articles to promote cross-institutional and interdisciplinary collaboration among researchers and the practical development of the open sharing movement. *[Method/Process]* Taking the citing papers of the top 100 most-cited articles in *PLoS ONE* as the research object, we primarily employ citation analysis and social network analysis methods to reveal the content and relational characteristics of the *PLoS ONE* citing literature network. *[Result/Conclusion]* The quantity and cooperation rate of open sharing cooperation outcomes based on *PLoS ONE* have increased year by year, with significant multidisciplinary and cross-institutional cooperation features. Cooperation content focuses on natural science fields such as biology and environmental science, with relatively fewer studies in social sciences and humanities/arts, though interdisciplinary cooperation does exist. The author collaboration network exhibits multi-center and weak-tie characteristics; the institutional collaboration network forms a cooperation model with research institutes and universities at its core, with government agencies and enterprises participating collaboratively; and the disciplinary collaboration network demonstrates environmental adaptability and disciplinary inclusiveness, with strong cooperation degree and correlation among core disciplines.

**Keywords:** open access; open sharing; cooperative behavior; citing papers; *PLoS ONE*

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Scientific and technological development relies on communication and cooperation among researchers. With the growth of open science, using open sharing research outcomes for interdisciplinary and cross-regional collaboration has become a new trend and important pathway in scientific research [1]. Open access journal articles, as a crucial practice of the open science movement, enable researchers to access and utilize academic resources online without economic, legal, or technical restrictions due to their completely free access publishing model [2], achieving the goal of maximizing open sharing of academic outcomes. Current research on open sharing cooperation mainly focuses on: open sharing cooperation framework studies, such as strategic-oriented, supply/service-oriented, and management-oriented subject division frameworks in scientific data [4], and visualization frameworks for social media data [5]; open sharing cooperation model studies, including government data open sharing cooperation models such as intergovernmental cooperation, government-enterprise cooperation, and government-public cooperation [6-7], transnational co-construction models [8], and university-enterprise cooperation models for corporate data open cooperation [9]; and open sharing cooperation platform studies, such as Wikipedia [10],

the DigitalOcean scientific collaboration and publishing open source platform [11], and the LabKey Server scientific data integration and collaboration open source platform [12]. Although scholars have conducted the above explorations on open sharing cooperation behaviors and preliminary analyses of author collaboration relationships in domestic open access journals [13], they have not studied open sharing cooperation from the perspective of open access journal citing literature. *PLoS ONE* is the first interdisciplinary comprehensive open access journal, with advantages such as short publication delays, complete open access, broad disciplinary coverage, and advanced peer review systems [14], and has had a wide impact in the academic community [15-16]. Its articles and citation data are often used as sample data sources for relevant quantitative research [17-20]. Additionally, *PLoS ONE* has a high citation count, with a total of 857,723 citations in 2020 [21], indicating its high degree of open sharing and making it a typical example for journal citing literature analysis. We argue that citing an open access academic journal article constitutes sharing a piece of scientific data. Therefore, using *PLoS ONE* citing literature as raw data to study how people use open access journal papers to conduct cooperation research can provide new ideas for revealing open sharing cooperation in the open science environment.

## 1 Data Sample and Research Methods

### 1.1 Data Sample

We selected the top 100 most-cited papers published in *PLoS ONE* from its inception in 2006 to 2020 as the reference analysis sample. In the Web of Science (WoS) Core Collection database, we retrieved papers from this period that cited *PLoS ONE* (retrieval date: April 7, 2021), obtaining 83,757 citing papers. After cleaning duplicate, irrelevant, and incomplete data (missing authors, titles, etc.), we obtained 83,060 valid citing papers (the sample data), forming the *PLoS ONE* citing literature network (hereinafter referred to as the “*PLoS ONE* network”). Between 2007 and 2020, the number of these citing papers continued to increase. Author-coauthored papers totaled 80,505 (96.92%, involving 35,903 authors), with the author cooperation rate remaining above 90%. Institution-coauthored papers totaled 61,678 (74.26%, involving 43,695 research institutions), with the institutional cooperation rate steadily increasing from 58.74% in 2008 to 76.96% in 2020. Interdisciplinary cooperation papers totaled 35,083 (42.23%), involving 207 of 254 WoS disciplines [22], with the disciplinary cooperation rate slightly decreasing, as shown in [Figure 1: see original paper].

### 1.2 Research Methods

We primarily employ citation analysis and social network analysis methods, using data from citing papers including titles, authors, keywords, author affiliations, disciplines, and publication years. We utilize VOSviewer visualization software for cluster analysis of high-frequency keywords in citing papers to explore content characteristics of the *PLoS ONE* network cooperation. We use

Ucinet and Netdraw software for network measurement and structural analysis of author, institutional, and disciplinary collaboration relationships in the *PLoS ONE* network. Network measurement involves network density, network paths, and network centrality analysis [23]. Structural analysis is conducted through structural holes and core-periphery analysis [24]. Structural holes are described using four metrics: effective size, efficiency, constraint, and hierarchy [25]. Core-periphery analysis divides positions by calculating the closeness of connections between subjects [26].

## 2 Analysis of *PLoS ONE* Network Collaboration Content Characteristics

High-frequency keywords within literature represent research hotspot areas, and establishing keyword co-occurrence networks can reflect core content in current collaborative research [27]. We calculate core keywords based on Price's Law  $K = 0.749\sqrt{N_{\max}}$ , where  $N_{\max}$  represents the highest frequency of keyword occurrence in the sample literature. In the *PLoS ONE* network, the most frequent keyword "microbiome" appeared 1,148 times, so we selected 1,340 keywords appearing  $K = 0.749\sqrt{1148} \approx 26$  times or more as core keywords. After clustering these core keywords using VOSviewer software, we obtained eight keyword clusters: neurobiology (Cluster 1), epidemiology (Cluster 2), metabolic diseases (Cluster 3), immunology (Cluster 4), transcriptomics (Cluster 5), proteomics (Cluster 6), ecosystems (Cluster 7), and biological evolution (Cluster 8), as shown in [Figure 2: see original paper]. The figure illustrates the keyword co-occurrence network, where node size indicates keyword frequency and line thickness represents connection strength. The analysis reveals: The core keyword co-occurrence network shows relatively high overall aggregation, indicating high integration of cooperation content in the *PLoS ONE* network; and Cooperation content in the *PLoS ONE* network mainly concentrates on natural science fields such as biology and environmental science, with relatively fewer studies in social sciences and humanities/arts, possibly related to the establishment of many natural science open science data centers or repositories abroad (e.g., "GenBank"). The network core keyword co-occurrence is shown in [Figure 2: see original paper].

## 3 Analysis of *PLoS ONE* Network Collaboration Relationship Characteristics

From three perspectives—authors, institutions, and disciplines—we constructed 1-mode symmetric matrices. For example, if citing paper X was coauthored by core authors A, B, and C, we established weighted connections (weight = 1) between A-B, A-C, and B-C to build the core author collaboration 1-mode matrix. Other 1-mode matrices follow similar construction. These matrices can then be imported into Ucinet for relevant collaboration relationship characteristic analysis.

### 3.1 Author Collaboration Relationship Characteristics

Author collaboration relationships most intuitively reflect scientific research influence [28]. To distinguish authors with identical names, we used author affiliations as an auxiliary means for machine identification. Statistical results show that the most prolific author is Rob Knight (R. Knight) with 84 papers. Using Price's formula, we calculated  $K = 7$  or more papers for 3,257 authors, then removed solo authors to obtain 2,727 core authors. Core author collaboration characteristics manifest in two main aspects:

**3.1.1 Network Measurement of Core Author Collaboration** Ucinet calculations show the overall network density of core author collaboration is 0.001, indicating a relatively sparse network with weak connections. The average path length of the core author collaboration network is 3.5, meaning that on average, any two core authors require fewer than four intermediaries to establish collaborative contact, conforming to the “six degrees of separation” theory [29]. Thus, although the *PLoS ONE* core author collaboration network has high connectivity, the sparse network density reflects relatively loose core author collaboration relationships, showing small-group and multi-center characteristics. Network centrality reflects a node's position and importance in its network [30]. In the *PLoS ONE* core author collaboration network, point centrality rankings strongly correlate with betweenness centrality rankings (see ), indicating that highly influential authors also occupy important positions in the collaboration network. For example, Rob Knight, with the most publications, has the highest point centrality and betweenness centrality, meaning he possesses strong discourse power, occupies the most central paths in the network, and can conveniently connect with other authors in the *PLoS ONE* network. This corroborates the view that “author point centrality positively correlates with publication volume” [31-33]. Closeness centrality shows a different pattern: the top 10 authors by point centrality all have relatively low closeness centrality, possibly because authors with high point centrality already have high academic status and research capabilities, can accurately grasp research hotspots and directions, and conduct independent research with low dependence on other authors.

To further reveal the core author collaboration network, we selected the top 10% of core authors by point centrality as key core authors to study their internal relationships. These key core authors formed nine subgroups, with the largest Subgroup 5 being the microbiology research group led by Rob Knight, comprising 97 people and connected with Subgroups 2, 3, 6, 7, and 9. The smallest subgroup had only three members (see ). Subgroups 1, 4, and 8 were isolated with no connections to other subgroups. Line thickness distribution within subgroups was uneven. Key core authors are mainly distributed in Asia, America, and Europe, focusing on biology, microbiology, neuroscience, and genetics. In the largest Subgroup 5, 38 key core authors collaborated with Rob Knight more than twice (see ). This group shows: Strong institutional correlation in high-frequency collaboration phases, as the top two collaborators by frequency belong

to the same institution as Rob Knight, indicating his preference for collaborating with same-institution authors; Cross-regional characteristics, with collaborators from different U.S. regions, such as Emily Vogtmann (E. Vogtmann) in New York, who collaborated six times despite being thousands of miles away, though cross-regional collaboration frequency is relatively low; and Few international collaborators, with only one non-U.S. author appearing in two collaborations, two non-U.S. authors in three collaborations, and no non-U.S. authors in four or more collaborations.

**3.1.2 Positional Analysis of Author Collaboration Relationships** Positional analysis of *PLoS ONE* network core author collaboration reveals: Core authors' effective size and efficiency correlate significantly with point centrality—higher point centrality yields higher effective size or efficiency. For example, Rob Knight has the highest effective size (113.77) in the collaboration network, indicating the most non-redundant relationships and least constraint, confirming his dominant position; The top 10 authors by point centrality have low constraint and hierarchy levels. Hierarchy refers to the degree to which constraint concentrates on one actor—higher hierarchy indicates more restriction [25]. For instance, Rob Knight's hierarchy is only 0.164, indicating more efficient action by high point centrality authors with fewer restrictions from others, consistent with network measurement results. Additionally, core-periphery measurements show 48 core authors (1.9%) in the network core position, all within the top 10% by point centrality and betweenness centrality, demonstrating that high-influence authors occupy central network positions and play active roles in collaboration.

### 3.2 Institutional Collaboration Relationship Characteristics

Institutional collaboration relationships reflect the status and effectiveness of domestic and international institutional collaborative innovation [34]. The most prolific institution in the *PLoS ONE* network is the Chinese Academy of Sciences with 2,076 papers. Using Price's formula, we calculated  $K = 35$  or more papers for 1,152 core institutions.

**3.2.1 Network Measurement of Institutional Collaboration** The core institutional collaboration network density in the *PLoS ONE* network is 0.097, indicating a relatively sparse network but slightly stronger than domestic university research collaboration networks (density 0.019) [35] and domestic humanities/social sciences institutional collaboration networks (density 0.003) [36], representing more collaborative research in the *PLoS ONE* network. The average path length is 2.0, indicating a good institutional collaboration environment where relevant information can be rapidly transmitted among institutions. Core institutional network centrality data (see ) show that institutions ranking high in point centrality and betweenness centrality are primarily research institutions and universities, with most institutions appearing in both rankings, indicating

that institutions with high point centrality also have high betweenness centrality and play stronger bridging roles with greater influence. Among the top 10 institutions by closeness centrality, nine are universities, indicating strong initiative among universities in institutional collaboration. China's State Oceanic Administration has high closeness centrality, demonstrating that relevant government departments have become important promoters of scientific data open sharing.

### 3.2.2 Positional Analysis of Institutional Collaboration Relationships

Positional analysis of core institutional collaboration in the *PLoS ONE* network reveals: Institutions with high point centrality and betweenness centrality (e.g., Chinese Academy of Sciences) have relatively high effective size and efficiency, with constraint decreasing as centrality increases, indicating more convenient communication and more efficient collaboration; The core institutional network has strong overall information sharing capacity with few restrictions from other institutions—even the most constrained institution, Jawaharlal Nehru University, has a constraint of only 0.226; Compared with core author structural holes, the core institutional collaboration network has more numerous and complex structural holes, indicating more opportunities for institutional cooperation. Additionally, core-periphery measurements show that institutions with higher point centrality and betweenness centrality occupy more central positions, such as the Chinese Academy of Sciences, Oxford University, and Harvard Medical School. However, institutions with higher closeness centrality tend to be more peripheral—for example, Ajou University in South Korea, which ranks first in closeness centrality, is located at the network periphery, indicating that while these institutions are closer to influential institutions, this does not necessarily mean they establish more collaborative relationships with them.

### 3.3 Disciplinary Collaboration Relationship Characteristics

Studying disciplinary collaboration relationships helps enhance the effectiveness of different disciplines jointly solving comprehensive and complex problems. We adopt the mainstream WoS Subject Categories (SCs) as the disciplinary classification basis, using Price's Law to calculate  $K = 70$  or more papers for 102 core disciplines, forming the *PLoS ONE* core disciplinary collaboration network (see [Figure 3: see original paper]), where the most frequent discipline is “Environmental Sciences & Ecology” with 8,664 citing papers. In [Figure 3: see original paper], node size represents the number of papers in that discipline, and line thickness represents interdisciplinary collaboration strength.

**3.3.1 Network Measurement of Disciplinary Collaboration** The core disciplinary collaboration network density in the *PLoS ONE* network is 0.129, indicating relatively weak overall cohesion. In [Figure 3: see original paper], lines connecting biochemistry & molecular biology, environmental sciences &

ecology, cell biology, and other biological research fields are relatively thick, indicating that biological research has the highest demand for and most outcomes from *PLoS ONE* papers, consistent with the view that biological disciplinary knowledge repositories are relatively well-developed [37]. The network's average path length is 2.1, meaning any two core disciplines require only about two intermediary disciplines to establish collaborative relationships, indicating high disciplinary connectivity. Additionally, thicker lines appear not only between disciplines with many published papers but also between some disciplines with fewer papers but high collaboration intensity, such as chemistry and immunology, possibly because major current epidemics have influenced disciplinary collaboration tendencies and corroborate the environmental adaptability of disciplinary collaboration.

Among the top 10 disciplines by point centrality, natural science disciplines predominate, mostly related to biological research, highlighting biology's central and important position in *PLoS ONE* network cooperation (see ). From the closeness centrality perspective, besides natural sciences, social science disciplines (e.g., Information Science & Library Science) appear in the top 10, indicating strengthening interdisciplinarity and increasing closeness between natural and social science research. From the betweenness centrality perspective, engineering has the highest value, occupying an absolutely core position in the network with strong information dissemination control capabilities. Overall, core disciplines in the *PLoS ONE* network show strong cooperation degree and correlation.

### 3.3.2 Positional Analysis of Disciplinary Collaboration Relationships

Positional analysis of core disciplinary collaboration in the *PLoS ONE* network reveals: The network contains extensive structural holes, with environmental sciences & ecology (ranking first in point centrality) having an effective size of 38.837, indicating it occupies the most structural hole positions and builds numerous connections for interdisciplinary cooperation; Disciplines with high point centrality not only influence similar disciplines but also connect non-similar disciplines—for example, computer science has a constraint of 0.098, showing strong agency in interdisciplinary cooperation that facilitates cross-disciplinary scientific data flow; Forestry has the highest hierarchy value (0.093), indicating few restrictions on disciplines and the absence of absolutely dominant disciplines, reflecting the inclusive characteristics of open cooperation research. Additionally, core-periphery measurements show that 34 core disciplines with high point centrality (33.3%), such as agriculture, biochemistry & molecular biology, psychology, and mathematics, occupy the network core, while social sciences and humanities/arts disciplines with low point centrality (e.g., business & economics, linguistics, law) are more peripheral. Notably, disciplines in the top 10 by closeness centrality (e.g., rheumatology, medical ethics) are all located in peripheral network areas, indicating low influence and poor collaboration capacity.

### 3.4 Analysis of Relationships Among Authors, Institutions, and Disciplines

To further explore relationships among core authors, institutions, and disciplines in the *PLoS ONE* network, we constructed 2-mode matrices for discipline-institution, institution-author, and author-discipline relationships based on citing literature data. [Figure 4: see original paper] shows relationships between the top two disciplines by point centrality and their strongest associated institutions and authors, where square nodes represent authors, triangles represent institutions, circles represent disciplines, and line thickness reflects association strength.

Overall, core authors, institutions, and disciplines have close relationships— institutions can establish cooperative relationships through relevant authors or disciplines, and different disciplines can generate interdisciplinary associations through relevant research institutions or authors, forming three types of promotion relationships: **“Discipline-Institution” cyclic promotion relationship:** During research, disciplines can connect through the same research institution (e.g., biochemistry & molecular biology and environmental sciences & ecology can associate through the Chinese Academy of Sciences), while institutions can associate by solving problems in the same disciplinary field (e.g., University of Washington and Chinese Academy of Sciences can establish cooperation by jointly addressing research questions in biochemistry & molecular biology). Thus, institutional cooperation promotes sustainable disciplinary development, and innovative interdisciplinary research consolidates inter-institutional connections, forming a positive cycle. **“Discipline-Author” cyclic promotion relationship:** On one hand, authors establish extensive cooperative relationships to solve disciplinary research problems; on the other hand, different disciplines can associate through the same author’s multi-domain research based on their own research interests and capabilities (e.g., authors Li Dezhu and Zhu Yongguan associate biochemistry & molecular biology with environmental sciences & ecology through their own interdisciplinary research directions), enabling mutual promotion between disciplines and authors. **“Institution-Author” cyclic promotion relationship:** Authors affiliated with the same institution generate more cooperation due to communication convenience. **“Author-Institution-Discipline” multi-cyclic promotion relationship:** Authors affiliated with multiple research institutions can not only bridge cross-institutional cooperation but also promote interdisciplinary collaboration. For example, author Paul Aisen, employed by both University of Washington and UC Berkeley, plays a connecting role in cross-institutional cooperation. Authors can also use relevant institutional resources or disciplinary advantages to cooperate with authors from different institutions and disciplines. Thus, the *PLoS ONE* network has the capacity to absorb knowledge from different authors, institutions, and disciplines, forming three dual-cyclic promotion relationships (“discipline-institution,” “discipline-author,” “institution-author”) and one multi-cyclic promotion relationship (“author-institution-discipline”),

thereby promoting interdisciplinary, cross-institutional, and cross-regional cooperation.

#### 4 Conclusions and Implications

Based on the proposition that citing an open access academic journal article constitutes sharing a piece of scientific data, we selected 83,060 citing papers of the top 100 most-cited *PLoS ONE* articles published between 2006 and 2020 as sample data to construct the *PLoS ONE* citing literature network. By analyzing the network's content and relational characteristics, we draw the following conclusions: (1) Both the quantity of open sharing cooperation outcomes and the cooperation rates of authors and institutions based on *PLoS ONE* show a year-by-year increasing trend, involving 207 WoS disciplines and 43,695 institutions, with very significant multidisciplinary and cross-institutional cooperation features. (2) Open sharing cooperation content based on *PLoS ONE* has strong disciplinary concentration, focusing on natural science fields such as biology and environmental science, with relatively fewer social science and humanities/arts studies, though some research involves information science & library science, computer science, and other fields, demonstrating interdisciplinary cooperation characteristics. (3) Open sharing cooperation relationships based on *PLoS ONE* overall show network characteristics of uneven node distribution and complex connection relationships: The author collaboration network shows multi-center and weak-tie features with obvious subgroup characteristics, primarily featuring same-institution cooperation within subgroups, and authors with high point centrality have more freedom of action and occupy more central positions; The institutional collaboration network has formed a cooperation model with research institutes and universities at the core and government agencies and enterprises as collaborative participants, with the Chinese Academy of Sciences and Harvard University occupying core positions in institutional cooperation; and The disciplinary collaboration network has good environmental adaptability and reasonable structural distribution. Although social sciences and humanities/arts disciplines are relatively peripheral, natural and social sciences show strong correlation, forming a disciplinary cooperation network with certain inclusiveness.

The current period is crucial for Chinese scholars exploring the transformation of scientific knowledge production paradigms [38]. Based on the cooperation behavior characteristics of the *PLoS ONE* network, promoting open sharing cooperation can be considered from two aspects: **Construct open sharing exchange and cooperation platforms.** High-quality cooperation among researchers depends on the construction of open sharing exchange platforms. As multidisciplinary and cross-institutional cooperation trends strengthen, and to address the issue of relatively few social sciences and humanities/arts cooperation studies in open sharing cooperation research, China should accelerate the construction of open sharing exchange and cooperation platforms covering all fields. China's 14th Five-Year Plan and 2035 Vision Goals explicitly

propose building major scientific and technological innovation platforms and a national high-end platform for research papers and scientific and technological information. In the future, we should further accelerate the construction of authoritative and professional all-domain open sharing exchange and cooperation platforms with parallel online and offline service models to reduce the burden of cross-regional cooperation on researchers and lower data sharing and utilization costs. **Improve open sharing cooperation incentive mechanisms.** Cooperation is difficult to achieve without incentive mechanisms for researchers. Institutions should improve corresponding incentive mechanisms to promote researchers' cooperation enthusiasm. For example, the UK's Joint Information Systems Committee (JISC) and Wiley signed a four-year "read and publish" agreement allowing UK university researchers to publish in Wiley open access journals free of charge without paying article processing fees [39]. This program reduces research costs while enabling faster and broader dissemination of research outcomes. Therefore, China should also accelerate the improvement of open sharing cooperation incentive mechanisms to meet researchers' relevant needs.

## References

- [1] UIDERWIJK A. Analysing open data in virtual research environments: new collaboration opportunities to improve policymaking [J]. *International journal of electronic government research*, 2017, 13(4): 76-92.
- [2] Chen Xinlan, Gu Liping, Liu Jinya. Transformation and practice of open publishing policies in publishing groups under the background of open science [J]. *Chinese Journal of Scientific and Technical Periodicals*, 2020, 31(11): 1289-1298.
- [3] Du Xingye, Li Hanxiao, Peng Lin, et al. Concept, content, and current situation of digital academic services in scientific journals [J]. *Chinese Journal of Scientific and Technical Periodicals*, 2021, 32(8): 998-1006.
- [4] Zhu Ling, Li Guojun, Wu Yue. Subject division frameworks and implications in foreign scientific data open sharing policies [J]. *Library and Information Science Knowledge*, 2020, 37(1): 94-104.
- [5] Malandri D, Manno I, Palmieri G, et al. An architecture for social sharing and collaboration around open data visualizations [C]// Gergle D, Morris M R. 19th ACM conference on computer supported cooperative work and social computing companion. New York: SIGCHI, 2016: 357-360.
- [6] Huang Ruhua, Chen Chuang. Cooperation models for U.S. government data open sharing [J]. *Library and Information Service*, 2016, 60(19): 6-14.
- [7] McBride K, Toots M, Kalvet T, et al. Open government data-driven co-creation: moving toward citizen-government collaboration [C]// Parycek P, Glassey O, Janssen M, et al. 18th international conference on electronic government. Krams: Springer, 2018: 184-195.
- [8] Wu Lin, Wu Shiyu. European open government data cooperation models and implementation: cross-regional co-construction and sharing paradigm [J]. *Information and Documentation Services*, 2017, 38(4): 75-80.

- [9] Pan Xing, Zhou Shenghan, Li Daqing, et al. Practice of university-enterprise cooperative research training model based on corporate open data: taking Beihang University as an example [J]. Chinese University Science and Technology, 2020, 26(10): 54-58.
- [10] Xia Shaoxu, Xu Jing. Wiki: an ideal of openness, equality, cooperation, and sharing [J]. Nanjing Social Sciences, 2008, 19(2): 128-131.
- [11] Caron B, Toole D, Wicks P, et al. Digital Ocean: building a platform for scientific collaboration and social media sharing on the Drupal content management system [J]. Earth science informatics, 2011, 4(4): 191-196.
- [12] Nelson E K, Piehler B, Eckels J, et al. LabKey Server: an open source platform for scientific data integration, analysis and collaboration [J]. BMC bioinformatics, 2011, 12(1): 1-23.
- [13] Wanyan Dengdeng, Sheng Xiaoping. Author collaboration relationships in domestic open access research papers [J]. Library and Information Service, 2014, 36(7): 42-45.
- [14] Lin Zhangbi. Evolution of large-scale comprehensive open access journals abroad and its implications for founding similar journals in China [J]. Acta Editologica, 2021, 33(1): 114-118.
- [15] Zimmer J. A positive review for PLoS ONE [J]. Science, 2010, 330(6000): 34.
- [16] Zhang Xiaolin, Li Lin, Liu Xiwen, et al. Open access academic information resources: approaching the “mainstreaming” turning point [J]. Library and Information Service, 2012, 56(9): 42-47.
- [17] Song Liping, Wang Jianfang, Liu Rui. Research on scientific evaluation dimensions based on principal component analysis: taking PLoS ONE as an example [J]. Library and Information Service, 2014, 58(17): 119-124.
- [18] Ding J, Liu C, Zheng Q, et al. A new method of co-author credit allocation based on contributor roles taxonomy: proof of concept and evaluation using papers published in PLoS ONE [J]. Scientometrics, 2021, 126(9): 7561-7581.
- [19] Syamili C, Rekha R V. Do altmetric correlate with citation: a study based on PLoS ONE journal [J]. Collnet journal of scientometrics and information management, 2017, 11(1): 103-117.
- [20] Xu Shurui, Lu Chao, Zhang Chengzhi. Measuring interdisciplinary from the perspective of term citation: taking six disciplines in PLoS ONE as examples [J]. Journal of the China Society for Scientific and Technical Information, 2017, 36(8): 809-817.
- [21] PLoS ONE [EB/OL]. [2021-09-29]. <https://jcr.clarivate.com/jcr-jp/journal-profile?journal=PLoS%20ONE&year=2020&fromPage=%2Fjcr%2Fhome>.
- [22] Abramo G, D'Angelo C A, Costa F D. Identifying interdisciplinarity through the disciplinary classification of co-authors of scientific publications [J]. Journal of the American Society for Information Science and Technology, 2012, 63(11): 2206-2222.
- [23] Newman M E. The structure of scientific collaboration networks [J]. Proceedings of the National Academy of Sciences, 2001, 98(2): 404-409.
- [24] Sheng Ya, Fan Dongliang. Structural hole classification theory and its application in innovation networks [J]. Science Research, 2009, 27(9): 1407-1411.

- [25] Liu Jun. Whole network analysis: a guide to UCINET software (2nd edition) [M]. Shanghai: Gezhi Press, 2014: 243.
- [26] Wang Yafei, Fan Jie. Analysis of core-periphery structure of China's main functional areas [J]. *Acta Geographica Sinica*, 2019, 74(4): 710-722.
- [27] Huang Ruhua, Zhao Yang, Huang Yuting. International open science research progress [J]. *Library and Information Service*, 2021, 65(1): 140-149.
- [28] Qiu Junping, Liu Guohui. Author collaboration research based on social network and keyword analysis: taking the domestic knowledge management field as an example [J]. *Information Science*, 2014, 32(6): 3-7, 13.
- [29] Milgram S. The small world problem [J]. *Psychology today*, 1967, 2(1): 60-67.
- [30] Qiu Junping, Wang Feifei. Research on author collaboration relationships in domestic competitive intelligence field based on SNA [J]. *Library Tribune*, 2010, 30(6): 34-40, 134.
- [31] Huang Lixia, Ji Sutong. Research on author collaboration relationships in domestic reading promotion field based on SNA [J]. *Library and Information Service*, 2020, 64(7): 119-126.
- [32] Yang Wancheng, Hu Sunjie, Zhang Ruoyu. Analysis of cooperation networks and hotspots in editing and publishing studies in China [J]. *Chinese Journal of Scientific and Technical Periodicals*, 2017, 28(10): 959-964.
- [33] Qiu Junping, Zhan Zhuo. Visualization research on author collaboration relationships in *Journal of Library Science in China* based on SNA [J]. *Library*, 2013(6): 44-47.
- [34] Dong Yanbang, Liu Li. Evolution analysis of institutional cooperation networks of high-level papers in Chinese universities [J]. *Journal of Intelligence*, 2019, 38(11): 138-144, 157.
- [35] Cao Zhipeng, Pan Qiliang. Current status of scientific research innovation cooperation among Chinese universities: social network analysis based on co-authored papers in 2014 [J]. *Science and Technology Management Research*, 2017, 37(1): 93-98.
- [36] Hao Ruoyang, Lu Wanhui. Evolution of academic collaboration characteristics in Chinese humanities and social sciences [J]. *Journal of Intelligence*, 2018, 37(6): 124-132.
- [37] Bhardwaj R K. Open research data repositories: a content analysis to comprehend data equitable access [J]. *Journal of scientometric research*, 2019, 8(3): 135-142.
- [38] Chen Chuanfu, Li Qiushi. Open access to data makes science benefit more widely: progress and prospects of open science and scientific data open access in China [J]. *Journal of Information Resources Management*, 2020, 10(1): 4-13.
- [39] JISC. UK institutions and Wiley agree ground-breaking deal [EB/OL]. [2021-09-29]. <https://newsroom.wiley.com/press-releases/press-release-details/2020/Jisc-UK-Institutions-and-Wiley-Agree-Ground-Breaking-Deal/default.aspx>.

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**Publication Ethics Statement Issued by *Library and Information Service Magazine***

To strengthen and enhance academic norms, research integrity, and academic ethics in the entire process of academic paper writing, review, and editing, establish good academic atmosphere, promote the scientific spirit, resolutely resist academic misconduct, and establish and maintain a fair, just, and open academic exchange ecological environment, the *Library and Information Service Magazine* (including the editorial departments of *Library and Information Service* and *Knowledge Management Forum*) has formulated a publication ethics statement in February 2020 in combination with the actual situation of the two journals.

The publication ethics statement commits that the two journals will strictly abide by and implement national policies and regulations related to academic ethics and editing and publishing, and standardize the behaviors of authors, peer review experts, and journal editors in the entire editing and publishing process, and accept supervision from the academic community and the whole society. It includes three parts with a total of 15 clauses: I. Author Publication Ethics ( Academic papers are an important part of scientific research; Academic misconduct is a cancer of academic papers; Authors are the main contributors to academic papers; Author signatures reflect intellectual property rights and academic contributions; Academic papers must attach great importance to intellectual property rights and information security; Standardized citation of references is an important manifestation of academic norms; Great importance must be attached to the standardization of research data and management; Establish error correction and academic self-purification mechanisms). II. Peer Review Expert Publication Ethics ( Peer review is an important quality control mechanism for papers; Review experts should comply with relevant ethical guidelines and codes of conduct for paper review). III. Editor Publication Ethics ( Editors should be guardians of academic paper quality; Editors should play a monitoring role in academic ethics construction; Editors should be the last barrier to curb academic misconduct; Zero tolerance for academic misconduct).

Full text available at: <http://www.lis.ac.cn/CN/column/column291.shtml>

(News from this journal)

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

*Source: ChinaXiv — Machine translation. Verify with original.*