An SNA-Based Study of Author Collaboration in China's Reading Promotion Field (Postprint)

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Abstract

[Purpose/Significance] This study investigates co-authorship patterns in the field of reading promotion in China, identifies collaborative relationships among authors, and explores potential collaborations, aiming to foster collaborative research in the reading promotion domain. [Method/Process] Regarding the investigation of explicit collaborative relationships, social network analysis is employed to measure node centrality in the co-authorship network, systematically analyzing collaborations among authors in China's reading promotion field from three centrality attributes: degree centrality, closeness centrality, and betweenness centrality; for the study of potential collaborations, a TF-IDF keyword-weighted author keyword coupling strength algorithm is adopted to mine potential collaborative relationships among a core group of 122 authors, while UCINET and NETDRAW software are utilized to analyze the relational networks. [Results/Conclusions] The study reveals the characteristics of the existing co-authorship network among authors in China's reading promotion field, confirms that collaboration potential remains in this domain, provides new insights for collaboration directions among authors, and promotes the production of higher-quality research outcomes.

Full Text

Preamble

To produce higher-quality research outcomes, an increasing number of scholars are choosing to engage in collaborative research. When top-tier talent pools together, these strong alliances facilitate the exploration and development of emerging research directions within disciplinary fields. Therefore, analyzing author collaboration relationships within a field has become particularly important. As early as 1990, Wang Bing systematically studied co-authorship phenomena in China by examining co-authorship rates, author coefficients per document, co-author types, and collaboration intensity across nine important natural

science journals in 1988, representing one of the earliest systematic studies on co-authorship in China [1]. In 1996, Dang Yaru established a co-authorship network system from a systems engineering perspective and constructed its hierarchical structure model to explore relationships among co-authors [2]. Cheng Qikai was the first to utilize UCINET for co-authorship network analysis, collecting publication data from 17 archival science journals between 1998 and 2007, and using UCINET and Pajek as analytical tools to examine network characteristics and research group distribution from the perspectives of centrality and subgroups [3]. Evidently, research on co-authorship issues in library and information science is developing toward greater specialization and refinement. Reading makes humanity more cohesive and creative [4]. In recent years, as reading activities have gained increasing attention both domestically and internationally, research on reading promotion models has become a hot topic in library and information science. This study selects 18 core journals in library and information science in China, compiles all authors of papers in the reading promotion field from 2010 to 2019, identifies collaboration relationships among authors in this field, and deeply explores potential collaboration networks. It summarizes the distribution characteristics of co-authorship networks in reading promotion and possible trends, providing references for future collaboration directions and offering insights for policy formulation in the reading promotion domain.

2 Data Sources and Research Methods

2.1 Data Sources

The data sample for this study was obtained from the CNKI China Journal Full-text Database. To ensure representativeness, samples were selected from 18 core journals in library and information science (based on the CSSCI source journal directory (2017-2018) from Nanjing University's Social Science Evaluation Center [5], excluding *Archival Science Research* and *Archival Science Communications*). The search condition was "subject = 'reading promotion' " with the time period from January 1, 2010 to April 20, 2019, yielding 1,190 papers. After removing 42 papers without authors (mostly annual journal topic guidelines and call for papers without data reference value), the final sample consisted of 1,148 valid papers. The study primarily analyzed the title, author, keywords, and publication year of these samples.

2.2 Research Methods

This study primarily employs social network analysis to examine the selected core author group. Social network analysis is a theoretical and methodological framework for analyzing various relationship structures and their attributes in social networks, focusing on the relationship patterns among actors, and has been proven applicable to citation relationship studies [6]. Simultaneously, the study utilizes a TF-IDF keyword-weighted author keyword coupling strength algorithm to explore potential collaboration relationships among core authors.

Through self-developed programs and Excel functions, the author coupling matrix was constructed, followed by visualization analysis using UCINET and NETDRAW to examine relationships among core nodes from the perspective of centrality, aiming to provide insights for communication and collaborative research among authors in the reading promotion field.

3 Overall Analysis of Co-authors

3.1 Data Preprocessing

Preliminary statistics of the sample data revealed that among the 1,145 selected sample documents, 425 were co-authored papers, accounting for 36.8% of the total. The samples involved 1,261 authors in total, of which 828 participated in collaborations, representing 43.6% of all authors. Details are shown in Table 1 .

3.2 Selection of Core Author Group

Given the large number of co-authors identified, analyzing the entire dataset through social network analysis would be overly complex. Therefore, to make the analysis more targeted and intuitively reveal co-authorship patterns in China's reading promotion field, the core author group was selected according to Price's Law: authors who have published N or more papers are considered outstanding scientists, i.e., core authors. The calculation formula is N = 0.749√n_{max}, where n_{max} represents the highest number of papers published by any author in the collaborative network [7]. In the selected sample data, Professor Fan Bingsi had the highest publication count with 16 papers. Therefore, authors who published N = 0.749√16 3 or more papers were selected as core authors, resulting in a core author group of 122 individuals in China's reading promotion field, as shown in Table 2 . The following analysis will focus on these 122 authors.

4 Analysis of External Cooperation Relationships

4.1 Construction of Co-occurrence Matrix

A co-occurrence matrix conversion program was first used to process the 122 authors, constructing an external relationship matrix for co-authorship in China's reading promotion field. A partial view is shown in Table 3 .

4.2 Analysis of Core Authors' External Cooperation Relationships

Visualization analysis was conducted using NETDRAW, producing the cooperation network of 122 core authors shown in Figure 2 [Figure 2: see original paper]. In Figure 2, node size indicates the centrality of authors in the cooperation network, with the size and color intensity of rounded squares representing centrality levels based on collaboration frequency with other core authors. The

largest, brightest red rounded squares represent authors with the strongest centrality. Accordingly, Wang Yu, Wang Lei, Jiang Xiao, and Yu Shu exhibit the strongest centrality, each having collaborated with other core authors six times—the highest frequency. Each node represents a core author; 52 core authors appear as isolated points on the left side of the figure, indicating no collaborative relationships with other core authors. The figure clearly shows four closely-knit collaborative groups with five or more members: (1) Wang Yu, Wu Jin, Du Yang, Hu Yongqiang, Fu Yao, Liu??, Wang Lei; (2) Fan Wei, Li Guihua, Jiang Xiao, Zhao Liang, Li Xiaowei, Chun Jiao, Yu Shu; (3) Xu Tiancai, Wei Qunyi, Yang Xinya, Gu Shihui, Wang Ning; and (4) Mo Qiyi, Li Donglai, Fang Jiayao, Xi Huijuan, Li Shijuan. This demonstrates frequent cooperation and communication among members within these four groups.

In this study, collaborative relationships between authors are represented as edges, with the strength of cooperation indicated by line thickness—stronger relationships correspond to thicker lines. By establishing a threshold, the top 10 author pairs with the thickest connections are identified in Table 4 . Investigation of the institutional affiliations of these top 10 author pairs reveals that strongly collaborative pairs typically belong to the same institution.

The network density was calculated using UCINET, yielding a cooperation network density of 0.0213. Network density is computed as the ratio of actual edges to the maximum possible edges in a social network, expressed numerically to indicate the interconnectedness among nodes. Network density ranges from [0, 1], with d(G) = 1 for a fully connected network and d(G) = 0 for a network with no connections. However, networks with density = 1 essentially do not exist; the maximum density found in real networks is 0.5 [8]. Therefore, the calculated network density in this study is relatively low, indicating that China's reading promotion field features mostly small-group collaborations and lacks large-scale, closely-knit cooperation among core authors.

UCINET was employed to measure centrality in the cooperation network. Centrality is one of the earliest concepts used to describe the position and importance of individuals or organizations within their social networks, and can be divided into three forms: degree centrality, closeness centrality, and betweenness centrality [9]. Degree centrality refers to a node's central position in the network, typically measured by the number of directly connected nodes (degree). Closeness centrality calculates centrality based on the distance of connections between nodes—those closer to others have higher closeness centrality, measured by closeness. Betweenness centrality emphasizes a node's centrality across the entire network, representing the network's concentration or centralization—the extent to which the entire network is organized around a particular node or group of nodes—measured by betweenness [10]. Table 5 shows the top 10 core authors for each centrality measure. Jiang Xiao has the highest degree centrality, indicating the strongest cooperation capacity in the reading promotion field. Combined with Table 2, Jiang Xiao's publication count is 8, ranking 9th, which partially validates the claim that "authors with higher degree centrality

tend to have more publications" [11] and demonstrates that publication quantity significantly influences an author's position in the cooperation network. Fan Bingsi, Wang Dan, and Xie Rong consistently rank in the top 3 for both closeness and betweenness centrality, with betweenness values exceeding 0.2—far surpassing other core authors. This indicates that these three authors possess strong control over the cooperation network in the reading promotion field and play important roles in academic communication. The closeness centrality of the top 10 core authors shows relatively small differences in relational distances among authors within the field.

5 Analysis of Potential Cooperation Relationships

External cooperation networks represent actual relationships established through co-authored publications, whereas statistical analysis of shared keywords reveals that authors with similar research directions form a virtual new network—the potential relationship network [12]. For potential cooperation relationships, this study employs author keyword coupling analysis. This method analyzes relationships between authors by examining the coupling strength of their keywords. Compared to author co-citation analysis or author bibliographic coupling analysis, author keyword coupling directly describes the knowledge elements (keywords) of authors' documents to reveal content-based relationships, providing more direct and objective understanding of researchers' content and academic interests, and better explaining implicit academic relationships among authors in the same field [13]. Regarding the author keyword coupling strength algorithm, this study adopts the TF-IDF keyword weighting approach proposed by Zheng Ying [13] to mine potential cooperation relationships among the 122 core authors.

Considering that low-frequency keywords may also reflect certain research directions, they were retained. Using 1,865 keywords extracted from the 1,148 sample documents, a self-developed program performed TF-IDF weighting analysis to construct a weight matrix between the 122 core authors and the 1,865 keywords. Partial results are shown in Table 6 .

Based on the author coupling calculation method, coupling degrees between authors were computed to construct a coupling degree matrix. With 122 authors in this study and symmetric coupling relationships, a 122$×$122 triangular author coupling matrix was formed (with diagonal elements set to 1 to highlight maximum self-coupling). Partial results are shown in Table 7 .

Collaborative relationships among authors were then eliminated. The original external cooperation relationship matrix was modified by setting existing collaborative relationships to 0 and non-collaborative relationships to 1. Using Excel's MMULT function to multiply corresponding cells, the resulting matrix showed past collaborative relationships as 0, eliminating their influence on potential relationship research. To meet software operation requirements, the diagonal symmetry was filled with data to complete the author potential cooperation

relationship matrix, with partial results shown in Table 8 .

5.2 Analysis of Core Authors' Potential Cooperation Relationships

Given the 偶然性 (contingency) of keyword assignment, the resulting coupling degree values also exhibit contingency. Therefore, when conducting visualization analysis with NETDRAW, the coupling degree threshold was set at >0.3. Experimental results show this produces a clearer and more valuable cooperation network diagram. The resulting author potential cooperation relationship network is shown in Figure 3 [Figure 3: see original paper].

In Figure 3, the size and color intensity of rounded squares represent centrality levels—the larger and redder the square, the stronger the centrality. Thus, the largest node represents Li Haiyan as the author with strongest centrality. The strength of cooperation between authors is indicated by line thickness. By establishing a threshold, the top 10 author relationships with thickest connections are shown in Table 9 .

Table 9 reveals that except for the small group of Sun Jingqiong, Li Chenglong, and Xia Lixin, who remain concentrated at the School of Information Management, Central China Normal University, the other seven author pairs break geographical barriers, ranging from Northeast Normal University in the north to Dongguan Library in the south. The potential cooperation network based on keyword weighting connects authors with highly similar research directions. Network density calculation using UCINET yields a value of 0.1266—a significant increase compared to the external cooperation network—indicating stronger communication in the potential cooperation network derived from keyword weighting. This approach aggregates authors with high potential for collaboration who may not have previously worked together due to geographical distance or communication barriers.

Due to the coupling degree threshold, 28 authors became isolated points (without the threshold, all nodes would be connected). Network centrality analysis (Table 10) shows that Li Haiyan, Yang Li, Wang Dan, and Qin Hong have replaced Jiang Xiao, Yang Xinya, Xu Tiancai, and Wang Lei as core nodes in the potential cooperation network, suggesting these authors may lead research directions in reading promotion in coming years and play key roles in the field's development. From closeness centrality, authors such as Cao Juan, Zhou Yonghong, Wu ?, Zhang Jing, and Xie Rong show relatively close connections with other authors, a finding also supported by betweenness centrality, indicating these authors may become important connectors and communication bridges in the reading promotion cooperation network in the near future. Integrating these three centrality measures suggests that Cao Juan, Li Haiyan, Wu ?, Xie Rong, Zhang Jing, Zhou Yonghong, and others will be key nodes in China's reading promotion author cooperation network in the coming years.

Conclusion

This study reveals three main characteristics of China's reading promotion field: (1) Co-authorship has gradually increased in recent years, with the overall co-authorship rate rising steadily from 20% in 2010 to 46.3% in 2018, while the corresponding solo-authorship rate shows a clear declining trend. However, among all authors in the collected literature, collaborative authors account for less than half, with co-authored papers representing only 36.8% of the total, indicating that author participation in collaboration remains relatively low. Additionally, the core author group cooperation network density is only 0.0213, suggesting weak current communication and predominance of small-group collaborations. (2) The existing collaborative structure is highly fragmented. Figure 2 shows multiple small collaborative groups. While these small groups foster closer internal ties—especially larger groups centered around key authors that enhance members' centrality—the field as a whole suffers from severe clustering due to geographical and communication barriers, with minimal cooperation between groups, which hinders disciplinary development. Furthermore, two-person and three-person groups account for approximately half of all collaborative groups, often due to mentor-student relationships. However, these relationships are fragile and unlikely to persist long-term after student graduation, though they warrant attention and potential policy support to allow larger groups to mentor smaller ones, providing technical and theoretical guidance to enhance collaboration effectiveness while maintaining co-authorship rates. (3) Significant collaboration potential exists in China's reading promotion field. By analyzing author pairs with coupling degrees >0.3 (excluding isolated points and single connections), the vast majority of core authors belong to a k-core structure. The potential cooperation network density of 0.1266 represents a substantial improvement over the external cooperation network, indicating closer author communication. The top 10 strongest potential cooperation pairs demonstrate that the keyword-weighted network connects authors based on research direction similarity, largely overcoming geographical limitations. After excluding objective factors like geography and communication, key network nodes shift to Cao Juan, Li Haiyan, Wu ?, Xie Rong, Zhang Jing, Zhou Yonghong, and others as new field leaders. Centrality measures (degree, closeness, betweenness) all show significant enhancement, suggesting that determining collaboration relationships based on research interest consistency will better facilitate close cooperation among authors in the reading promotion field and further promote disciplinary development.

In summary, China's reading promotion field exhibits increasing co-authorship rates, fragmented current collaborative structures, and substantial future collaboration potential. Therefore, we recommend that authors strengthen communication, prioritize research direction alignment as the foundation for collaboration, overcome limitations such as geography and communication barriers, and enhance inter-group cooperation. The gradual improvement in co-authorship rates also reflects growing attention to reading promotion in China's library

and information science community. We will continue monitoring future author collaboration patterns in this field, anticipating that close cooperation among core authors will generate more high-quality research outcomes.

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Author Contributions

Huang Lixia: Research conceptualization and design, manuscript writing and revision; Ji Sutong: Data collection and processing.

Research on Author Cooperation Relationship in the Field of Domestic Reading Promotion Based on SNA

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Abstract: [Purpose/significance] This study examines the co-authorship of papers in the field of domestic reading promotion, identifies cooperation relationships among authors, and deeply explores potential collaboration relationships to promote cooperative research in the reading promotion field. [Method/process] At the external cooperation research level, based on social network analysis, centrality measurement of cooperative network nodes was conducted from three attributes: degree centrality, closeness centrality, and betweenness centrality, providing systematic analysis of author cooperation relationships in China's reading promotion field. At the potential cooperation research level, the TF-IDF keyword-weighted author keyword coupling strength algorithm was used to mine potential cooperation relationships among 122 core authors, while UCINET and NETDRAW software were employed for network analysis and diagram plotting. [Result/conclusion] The study reveals characteristics of existing author cooperation networks in China's reading promotion field, verifies untapped collaboration potential, provides new ideas for author cooperation directions, and promotes the production of higher-quality research outcomes.

Keywords: SNA; reading promotion; author cooperation

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