

Global Research Performance and Development of Social Networks in Sociology: A Bibliometric Analysis

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Abstract. This study utilizes bibliometric analysis to examine the global research performance, focus, and trend of social networks in sociology, based on 1,407 articles retrieved from the Web of Science (WoS). The findings indicate that social networks are a well-developing and meaningful discipline, with rapid growth in productivity over time. The United States, the United Kingdom, and the Netherlands account for over 65% of the total sample, with the University of California Irvine and the journal Social Networks being significant contributors to the field. The most productive authors focused on cross-institutional and transnational cooperation, with themes related to social capital, social support, gender, social media, networks, and social network analysis. The thematic map reveals that social networks contribute to social capital, and social support is a developing and crucial theme for future research. This study provides objective evaluations of global academic performance, development status, and trends that can guide future research in sociology and social networks.

Keywords: bibliometrix, social networks, global performance, sociology

1. Introduction

The social network is a network of relations and properties formed by social units (i.e., people, organizations, groups) to each other. Social network analysis addresses a relatively stable system of relationships formed by individual members of society based on their interaction. It uses mathematical models and graph theory to study a structural analysis method between actor and actor, actor and social network, and social network, and social network. Social networks, as a discipline, has seen significant progress worldwide (Harrison 2011) (accounting for a history of over 100 years). The discipline of social networks has rapidly evolved from a niche research area to a key component of interdisciplinary studies, including sociology, psychology, business management, mathematics, and computer science. In 1977, Barry Wellman founded a professional association for social network analysis, called the International Network for Social Network Analysis (INSNA). Through the efforts and endeavors of numerous scholars, the field of social networks has become an area of research with four characteristics: 1) structural; 2) systematic correlated data; (3) graphical or community graphs, graph theory; (4) mathematical or computational models (Freeman 2004). This area has been widely explored since 1990s and had a significant impact over the years. The research dynamics of this field can be seen in the proliferating publication of academic papers in the field. However, previous studies have not systematically analyzed the published papers that are related to social networks, thus cannot provide a comprehensive assessment of current research performance in this field, but could only provide a subjective direction for future studies. Hence, a scientific review is needed for studies that address social networks.

Although there are many approaches for elucidating an academic field, bibliometric analysis ensures better objective and reliable analyses of a considerable volume of literature and can facilitate quantitative and qualitative analyses. In addition, bibliometric analysis is generally employed to evaluate and predict the future direction of publications. This unique tool, which was created by Massimo (2017) through R language, was reconstructed via a classical logical bibliometric workflow that includes many statistical and graphical tools. The range of bibliometric techniques includes counting production by authors, journals, institutions, and countries; citation analysis; co-authorship; co-citation; collaboration; and keyword frequency analysis between authors, publications, journals, and countries, etc. In general, evaluative measurement and relationship analysis are recognized as the main functions of bibliometric techniques (Benckendorff, 2009).

This research summarizes global academic evaluation, research priorities, and social network trends using statistical indicators and visual graphs. These findings provide a direct understanding of social networks in the sociological research field and provide directions for future research based on social network theories and integration of current issues.

2. Methodology

Bibliographic data were retrieved from the Web of Science (WoS) Core Collection of Clarivate Analytic (WoS at <http://www.webofknowledge.com>) on November 23, 2021. WoS is among the world's largest comprehensive academic information resources, covering numerous disciplines, including a variety of core academic journals of the Science Citation Index (SCI), Social Science Citation Index (SSCI), and Arts & Humanities Citation Index (AHCI). WoS addresses the various research fields of natural science, sociology, and psychology.

As outlined below, Figure 1 shows the search processes and strategies for conducting social network research. The terms "social networks", "social network analysis", and "social network" are adopted in the previous literature, in order to ensure data integrity as far as possible, these three related keywords are used to search this field. This process produced 210,211 publications; Considering the data availability, refine employing "quick filter: open access"; English as an international common language, selected for "language: English"; Although popular in anthropology, medicine, computer science, and other fields, social networks are the most prominent in the field of sociology, so this study focuses on

analyzing "research area: sociology". The historical development of social networks was sorted out, which has been widely used since 1990, so refine it as "year: 1990–2021"; Considering the consistency of the evaluation criteria, "document type: article" is adopted. This procedure yielded 1,407 articles. All the information of the articles, including authors, keywords, journals, references, countries, citations, abstracts, and publication times, were downloaded and exported to a plain text file, which was subsequently saved. Following the aforementioned steps, the saved file was imported and executed to run a bibliometric analysis.

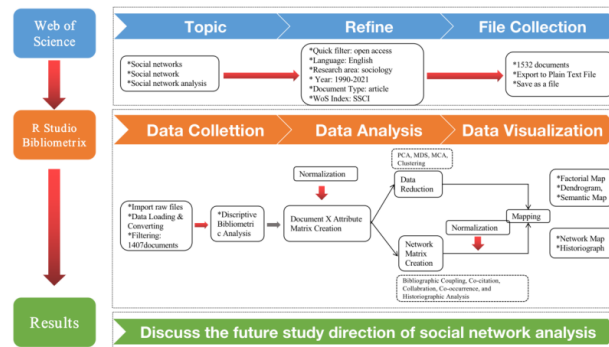


Fig. 1: Technical road map and the recommended science mapping workflow of the bibliometrix package.

This study employed the latest R version, MacOS 4.1.2, which was downloaded and installed on a computer (<http://cran.r-project.org>) (R Core Team 2020). Thereafter, the RStudio package (<http://www.rstudio.org/download/>), which exhibited debugging, visualization, and other functions and is an integrated development environment for R, was downloaded and installed. Aria and Cuccurullo (2017) created the Bibliometrix software as a professional literature analysis tool for conducting quantitative research in bibliometrics and scientometrics; its analysis process, as well as the recommended science mapping workflow, are shown in Figure 1. The operation process is, as follows:

1. Open RStudio and install Bibliometrix and its dependent programs by entering “install. Packages (‘Bibliometrix’)” in the console window, which is called the software Bibliometrix Package.
2. Select “Bibliometrix” in the system library.
3. Enter “library(bibliometrix),” and enter “biblioshiny ()” on a new line to run the program.
4. Automatically open a new window as the workflow begins to analyze the data.

3. Results

3.1. Main description of the dataset

All the descriptive information regarding the collected dataset are presented in Table 1. Altogether, 1,407 articles on “social networks,” “social network,” or “social network analysis” were retrieved from 1990 to 2021. This dataset included 133 sources, 62,234 references, and 2,805 authors, indicating that the co-authors per document and collaboration index were 2.43 and 2.42, respectively.

Table 1. Descriptive analysis: main information regarding the collection (1990–2021).

Description	Results
Sources (Journals, Books, etc)	133
References	62,234
Articles	1,407
Authors	2,805
Co-authors per articles	2.43
Collaboration index	2.42

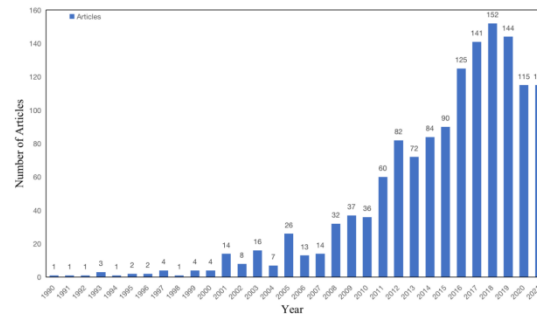


Fig. 2: Publications per year from 1990 to 2021.

The publication outputs of social networks between 1990 and 2021 are shown in Figure 2. The annual growth rate was approximately 16.54% during these years, with an average publication of 67 articles annually. From only 23 articles (1.63% in total articles) between 1991 and 2000, the number of publications increased to 1,065 articles (75.69%) between 2011 to 2020. Since 2016, the annual publication output has surged to over 100 articles. The rapid increase in the number of articles published globally signifies a good growth trend.

3.2. Research statuses of countries and institutions

3.2.1. Analysis of countries

Productivity and total citations are utilized as evaluative measures to rate the impact of scholarly performance. All the articles, which were distributed across 48 countries and regions, contributed to this research field. Notably, Figure 3-A contains two color bars, with the color difference based on the authors' different affiliations (Feld 2006): the red and blue bars refer to single-country publications (SCP) and multiple-country publications (MCP), respectively. A combination of SCP and MCP represents the entirety of the publications in a country. The top five most productive countries are the United States (460 articles, 32.69% of all articles), the United Kingdom (323 articles, 22.96%), the Netherlands (133 articles, 9.45%), Germany (61 articles, 4.34%), and Australia (44 articles, 3.13%) (Figure 3-A) (Guo, 2021). The publications from the United States accounted for over one-third of the articles from all the 48 countries, and the number of SCPs (387 articles) was much higher than that of MCPs (73 articles) (Figure 3-A).

Figure 3-B shows the top 10 countries with the highest number of citations. The United States accounted for the highest number of citations (26,161 citations), followed by the United Kingdom (7,486 citations), the Netherlands (3,201 citations), Germany (2,967 citations), and Australia (1,693 citations).

The collaboration map indicates that 34 countries (70.83% of the total countries) contributed to this research field. Additionally, the frequency of cooperation indicated the strength of the association among the countries (Figure 3-C) (Hanaki, 2007). The top five countries with the strongest tie strengths include the United States (191 times), the United Kingdom (222 times), the Netherlands (148 times), Germany (87 times), and Australia (56 times).

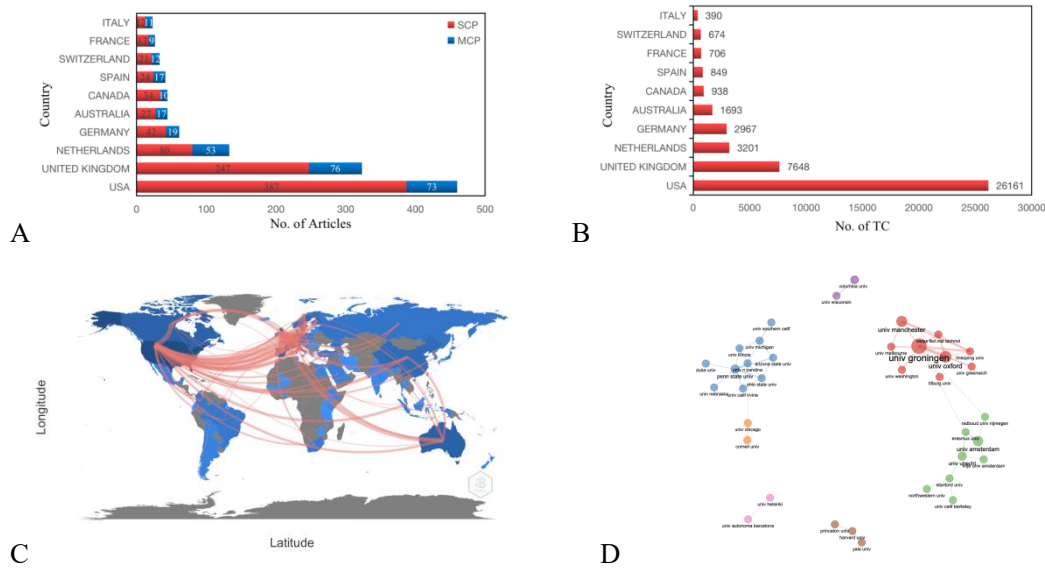


Fig. 3: (A) Top 10 most productive countries regarding social networks. no. of publications: number of publications. (B) Number of total global citations in different countries (No. of TC: number of total citations). (C) Collaboration map among countries. (D) Collaboration network among institutions.

3.2.2. Analysis of institutions

Overall, 947 affiliations were computed in this dataset by analyzing the most relevant affiliations. Within the period of interest, the University of Groningen published the highest number of articles (63 articles; 4.45% of the total articles), followed by the University of California Irvine (62 articles, 4.40%), University of Oxford (51 articles, 3.62%), University of Manchester (49 articles, 3.48%), and the University of Amsterdam (47 articles, 3.34%).

Such institutions can improve their academic levels through international cooperation in scientific research. The graph in Figure 3-D was generated by counting the collaboration networks of 61 institutions that had each published over 10 articles. Eventually, 36 institutions were finalized after 25 items without relevant cooperation were excluded. The Universities of Groningen (total tie strength = 148 times), California Irvine (108 times), Oxford (99 times), Manchester (93 times), and Amsterdam (83 times) accounted for the top five institutions with the highest total tie strength are the top 5.

Collaboration network as a method for exploring authors' cooperate network is one of the most scientific and well-documented forms. A collaborative network signifies the process of classifying clusters of different colors according to the first author. The collaboration network is categorized into clusters of red, blue, green, purple, dark yellow, yellow, and pink bubbles, which are separately labeled with the names of the institutions. The colors refer to the different associations among the articles; the link between the articles determines the cooperation relationship, and the size of the bubble specifies the normalized number of the frequency of collaboration computed by the articles. Lastly, the line refers to the strength of the collaboration tie, i.e., the larger the size, the more frequent the cooperation with other institutions (Zha 2021). The Universities of Groningen, Oxford, and Manchester are ranked the first, third, and fourth most productive institutions, respectively. Hence, the representative institutions located in the red cluster tend to cooperate more with each other than those in the other clusters. The University of Amsterdam is the fifth most productive university since its representative bubble is situated in green clusters. Further, some cooperation exists between the red and green clusters. Notably, the University of California Irvine, as a representative institution in the blue cluster, was the second most productive institution.

3.3. Research statuses of journals and authors

3.3.1. Analyses of journals

In total, all of these publications were published in 133 journals. The top 10 most productive journals on social networks are shown in Figure 4-A, and the statistical results for the top five journals included *Social Networks* (SN) (228 articles, 16.2% of all the publications), *Information Communication & Society* (IC&S) (67 articles, 4.76%), *Global Networks-A Journal of Transnational Affairs* (GN-AJTA) (53 articles, 3.77%), *American Journal of Sociology* (AJS) (47 articles, 3.34%), and *Social Science Research* (SSR) (42 articles, 2.99%). SN was established by Wellman B. in 1977, being the first journal founded by the professional association, INSNA. SN reported a compound impact factor of 3.406 in 2020, followed by IC&S (2020IF: 5.422), GN-AJTA (2020IF: 2.927), AJS (2020IF: 4.688), and SSR (2020IF: 2.322). Figure 4-B presents the dynamics of the top 10 most productive journals from 1990 to 2021. The rising lines refer to the increasing number of papers over time, highlighting a growth trend. Particular, SN has surged to over 50 publications per year since 2011.

The top 10 most cited journals include AJS (2630 citations), SN (2257 citations), ASR (2016 citations), ARS (1011 citations), and SF (845 citations) (Figure 4-C). A total of 81 journals with over 100 citations from the reference lists were analyzed via the co-citation network. They were also divided into red, green, and blue clusters. The distinct bubbles in the red cluster highlight the journals with the highest productivity, i.e., AJS, SN, and ASR. More correlations were evident among these three journals on social networks. The representatives of the green cluster include *New Media Sociology* (NMS), *Sociology*, and IC&S, which are more related to social science, media, and information communication. The representatives of the blue cluster are *Social Science Medicine* (SSM), *American Journal of Public Health* (AJPH), and *Journal Health and Social Behavior* (JHSB), which are more related to health, behavior, and medicine.

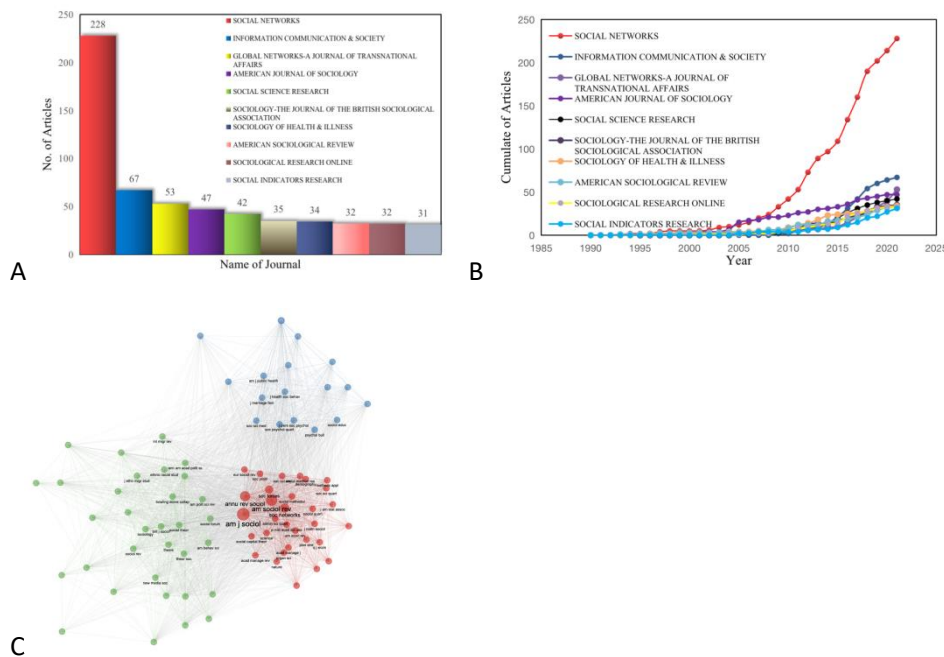


Fig. 4: (A) Top 10 most productive journals. (B) Dynamics of journals per year. (C) Co-citation network of journals.

Among the bibliometric evaluation techniques, the h-index (Costas 2007) is an impact indicator that assesses the performances or scientific contributions of journals. The evaluative measures derive the number of papers and the total number of citations; the higher the h-index of a journal, the greater the influence of such a journal. The impacts of the top 10 journals can be analyzed by understanding

the h-indexes of the authors (Table 2). Thus, the top five journals include *SN* (H-index, 50), *AJS* (33), *IC&S* (24), *ASR* (22), and *Sociology-The Journal of the British Sociological Association* (BSA) (19).

Table 2. H-indexes of the journals in the dataset.

Source	H-index	Total Citation	Number of Publications	% of Articles
Social Networks	50	9,948	219	15.57
American Journal of Sociology	33	7,495	47	3.34
Information Communication & Society	24	2,948	63	4.48
American Sociological Review	22	3,313	32	2.27
Sociology-the Journal of the British Sociological Association	19	1,177	34	2.42
Sociology of Health & Illness	17	910	32	2.27
Social Forces	16	1,608	23	1.63
Sociologia Ruralis	16	1,273	23	1.63
Global Networks-A Journal of Transnational Affairs	15	1,001	47	3.34
Media Culture & Society	15	666	26	1.85

3.3.2. Analyses of authors

The count of the authors' publications is shown in Figure 6-A, and the annual details of the publications and citations of the top 10 most productive authors from 2001 to 2021 are shown in Figure 5. The size of the circle indicates the number of articles, and the color denotes the number of citations. Accordingly, a larger circle corresponds to a higher number of publications, and a darker color corresponds to a higher number of citations (Zha 2021). The top five most productive authors were Snijders (12 articles, 0.85% of all articles), Hipp (10 articles, 0.71%), Moody (10 articles, 0.71%), Ryan (10 articles, 0.71%), and Butts (9 articles, 0.64%), accounting for a total of 51 articles. The outputs were almost the same, representing an average of approximately 10 articles per author.

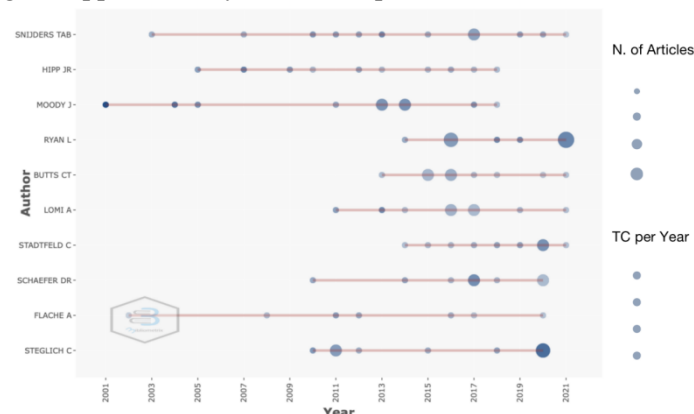


Fig. 5: Publications of top authors over time.

(N. of articles: number of articles; TC per year: total citations of articles per year)

Figure 6-C shows that Moody might be the most productive author in social networks research, ranking first with a total citation of 1,547, followed by Snijders (726 citations), Hipp (706 citations), Lomi (290 citations), and Steglich (270 citations). The h-index findings are shown in Figure 6-C, with Snijders (11), Hipp (9), Moody (9), Stadtfeld (8), and Lomi (7) accounting for the top five authors.

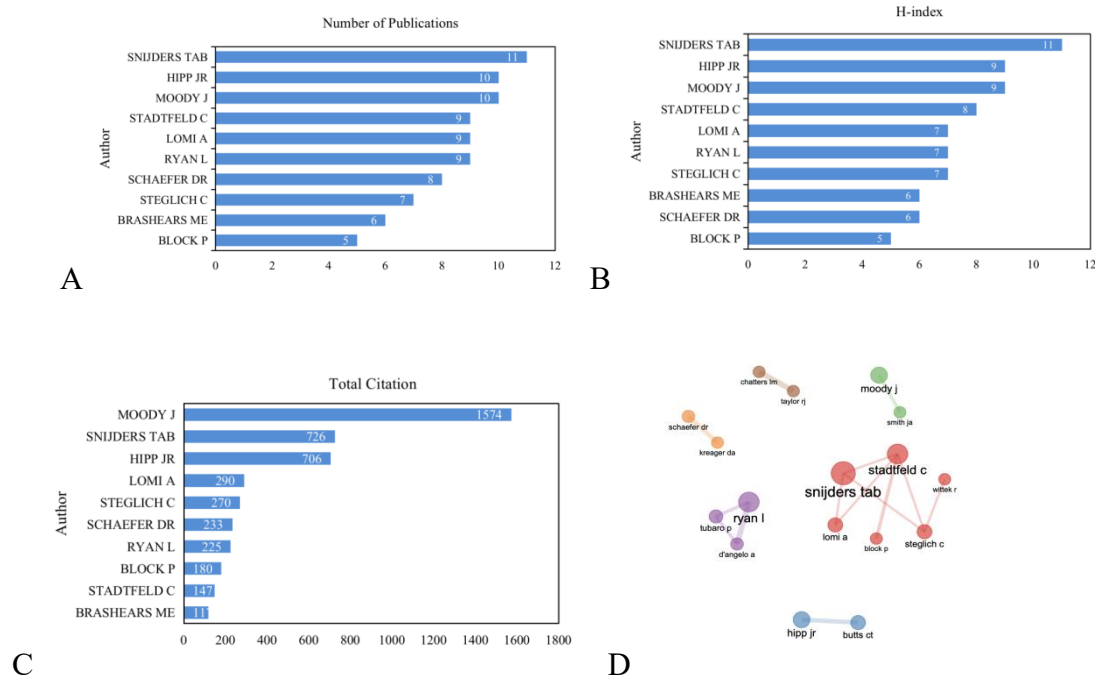


Fig. 6: (A) Total publications from authors. (B) H-indexes of authors in the dataset. (C) Total citations in the research field. (D) Collaboration network of authors.

In the figure showing the collaboration of authors, the nodes refer to the authors, and the lines specify the link between authorship. The nodes represent the authors, and the links represent co-authorships (Glänzel 2004). Notably, 28 authors with over five publications each were selected to analyze the collaboration network, and 11 authors who did not cooperate with other authors were excluded (Figure 6-D). The top five collaborative authors included Snijders (total tie strength = 32 times), followed by Hipp (28 times), Moody (28 times), Ryan (24 times), and Schaefer (23 times). These results demonstrated that Snijders, Stadtfeld, Steglich, and Lomi cooperated closely in the red cluster, and Ryan cooperated with D'angelo and Tubaro frequently in the purple cluster. Furthermore, Moody frequently cooperated with Smith in the green cluster, Hipp frequently cooperated with Butts in the blue cluster, and Schaefer frequently cooperated with Kreager in the green cluster.

3.3. Citation and co-citation analyses

Table 3 presents the top 10 most cited articles globally. “A faster algorithm for betweenness centrality” by Brandes was cited 2,039 times in 2001, followed by “Friends and neighbors on the web” by Adamic in 2003 (1,244), “The logic of connective action: Digital media and the personalization of contentious politics” by Bennett in 2012 (1,153), “Embeddedness in the making of financial capital: How social relations and networks benefit firms seeking financing” by Uzzi in 1999 (987), and “Social disconnectedness, perceived isolation, and health among older adults” by Cornwell in 2009 (877).

Table 3. Top 10 most cited articles globally; TC: total citations; TC per year: total citations per year.

Name of Article	Author	Year	Journal	TC	TC per Year
A Faster Algorithm for Betweenness Centrality	Ulrik Brandes	2001	Journal of Mathematical Sociology	2039	97.10
Friends and Neighbors on the Web	Lada A. Adamic	2003	Social Networks	1244	65.47
The Logic of Connective Action: Digital Media and the Personalization of Contentious Politics	W. Lance Bennett	2012	Information Communication & Society	1153	115.30

Embeddedness in the Making of Financial Capital: How Social Relations and Networks Benefit Firms Seeking Financing	Brian Uzzi	1999	American Sociological Review	987	42.91
Social Disconnectedness, Perceived Isolation, and Health among Older Adults	Erin York Cornwell	2009	Journal of Health and Social Behavior	877	67.46
Syndication Networks and the Spatial Distribution of Venture Capital Investments	Olav Sorenson	2001	American Sociological Review	846	40.29
Collaboration and Creativity: The Small World Problem	Brian Uzzi	2005	American Sociological Review	820	48.24
Complex Contagions and the Weakness of Long Ties	Damon Centola	2007	American Sociological Review	748	49.87
Race, School Integration, and Friendship Segregation in America	Moody James	2001	American Journal of Sociology	646	30.77

Table 4 presents the top 10 locally cited articles in this database. Moody's (2001) paper, "Race, school integration, and friendship segregation in America," received a total of 648 global citations and ranks first, followed by "Complex contagions and the weakness of long tie" by Centola in 2007 (748), "Recent developments in the exponential random graph (p*) models for social networks" by Robins in 2007 (392), "Effects of missing data in social networks" by Kossinets in 2006 (465), and "Curved exponential family models for social networks" by Hunter in 2007 (236).

Table 4. Top 10 locally cited documents in this database. LC: local citations, GC: global citations.

Document	Author	Year	Journal	LC	GC
Race, school integration, and friendship segregation in America	Moody James	2001	American Journal of Sociology	38	646
Complex contagions and the weakness of long ties	Damon Centola	2007	American Journal of Sociology	33	748
Recent developments in exponential random graph (P*) models for social networks	Garrrt Robins	2007	Social Networks	23	392
Effects of missing data in social networks	Gueorgi Kossinets	2006	Social Networks	21	465
Curved exponential family models for social networks	David R. Hunter	2007	Social Networks	20	236
Residential segregation and interracial friendship in schools	Ted Mouw	2006	American Journal of Sociology	19	180
The logic of connective action	W. Lance Bennett	2012	Information Communication & Society	19	1153
Embeddedness in the making of financial capital: how social relations and networks benefit firms seeking financing	Brain Uzzi	1999	American Sociologic Review	17	987
Longitudinal analysis of personal networks: the case of Argentinean migrants in Spain	Miranda Lubbers	2010	Social Networks	17	123
A model for the multiplex dynamics of two-mode and one-mode networks, with an application to employment preference, friendship, and advice	Tom A.B. Snijders	2013	Social Networks	17	130

Table 5 lists the top 10 most cited references. The top five highly cited references were Granovetter (*AJS*, 208 citations, 1973), McPherson (*ARS*, 173 citations, 2001), (*AJS*, 110 citations, 1988), Putnam (*Bowling Alone Collapse*, 107 citations, 2000), and Wasserman (*Methods Application*, 102 citations, 1994).

Table 5. Top 10 most cited references. TC: total citations.

Cited References	Citations
Granovetter MS, 1973, American Journal of Sociology, V78, P1360, DOI 10.1086/225469	208
McPherson M, 2001, Annual Review Sociology, V27, P415, DOI 10.1146/ANNUREV.SOC.27.1.415	173
Coleman JS, 1988, American Journal of Sociology, V94, PS95, DOI 10.1086/228943	110
Putnam R. D., 2000, Bowling Alone: The Collapse and Revival of American Community	107
Wasserman S., 1994, Methods Application	102
Coleman JS., 1990, FDN Social Theory, DOI 10.2307/2095759	90
Burt R. S., 1992, Structural Holes, DOI 10.1016/0149-7189(92)90095-C	82
Granovetter M, 1985, American Journal of Sociology, V91, P481, DOI 10.1086/228311	72
Portes A, 1998, Annual Review Sociology, V24, P1, DOI 10.1146/ANNUREV.SOC.24.1.1	69
Feld SL, 1981, American Journal of Sociology, V86, P1015, DOI 10.1086/227352	68

These 42 references were analyzed via the co-citations of over 30 citations (Figure 7-B). The nodes are the references, and the links are their co-citation relationships (Chang 2015; Leung 2017). The color refers to the associations with similar research topics, and the size represents the citations. Specifically, the size indicates the normalized number of citations and is divided into two color clusters, indicating four main topics. In the red cluster, the representatives were Granovetter (1973), Putnam (1988), Coleman (2000), and Lin (2004). McPherson (2001), Moody (2001), Snijders (2010), and Steglich (2010) were the representatives of the blue cluster.

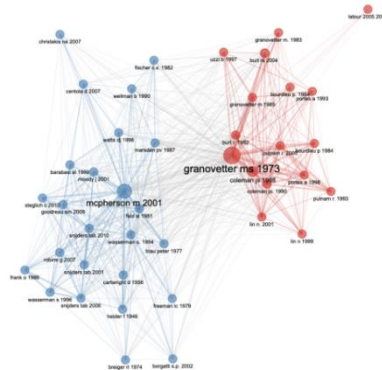


Fig. 7: Co-citation network of references

3.4. Frequent keywords and their co-occurrence analysis

The top 10 most frequently utilized authors' keywords and frequent keywords plus are listed in Table 5. Overall, social networks (185 times), social capital (75 times), social media (70 times), networks (60 times), and social network analysis (47 times) were the most frequently employed keywords. Networks (232 times), social networks (164 times), dynamics (83 times), health (66 times), and participation (62 times) were the most frequently utilized keywords plus (Table 5).

Table 6. Top 10 most frequently utilized authors' keywords and keywords plus.

Authors' Keywords	Frequency	Keywords plus	Frequency
social networks	185	networks	232
social capital	75	social networks	164

social media	70	dynamics	83
networks	60	health	66
social network analysis	47	participation	62
social movements	36	ties	60
social support	32	behavior	58
Twitter	31	model	56
homophily	24	gender	51
gender	22	power	50

Figure 8-A shows the co-occurrence network of 166 authors' keywords that were each selected over five times, and Figure 8-B shows the co-occurrence network of 336 keywords plus that were each utilized over five times. In the three-field plot, the three fields from left to right represent the sources, authors, and keywords in Figure 8-C, as well as the affiliations, authors, and keywords in Figure 8-D, respectively. The size of the rectangle denotes the normalized number of articles between the two fields, and the thickness of the lines refers to the number of the three-field ties (Zha 2021). Notably, the most productive journal (SN) includes almost all the authors that were related to social networks, social network analysis, networks, social support, social capital, etc. (Figures 8-C and 8-D). Additionally, Butts and Hipp were associated with the University of California Irvine, and Snijders, Stadtfeld, Steglich, Cornwell, and Flache were related to the University of Groningen, focusing on the research areas of the main related topic, focusing on homophily, education, social capital, dynamics, etc. Authors in other institutions also extended the research area by targeting social support, migration, culture, and transnationalism.

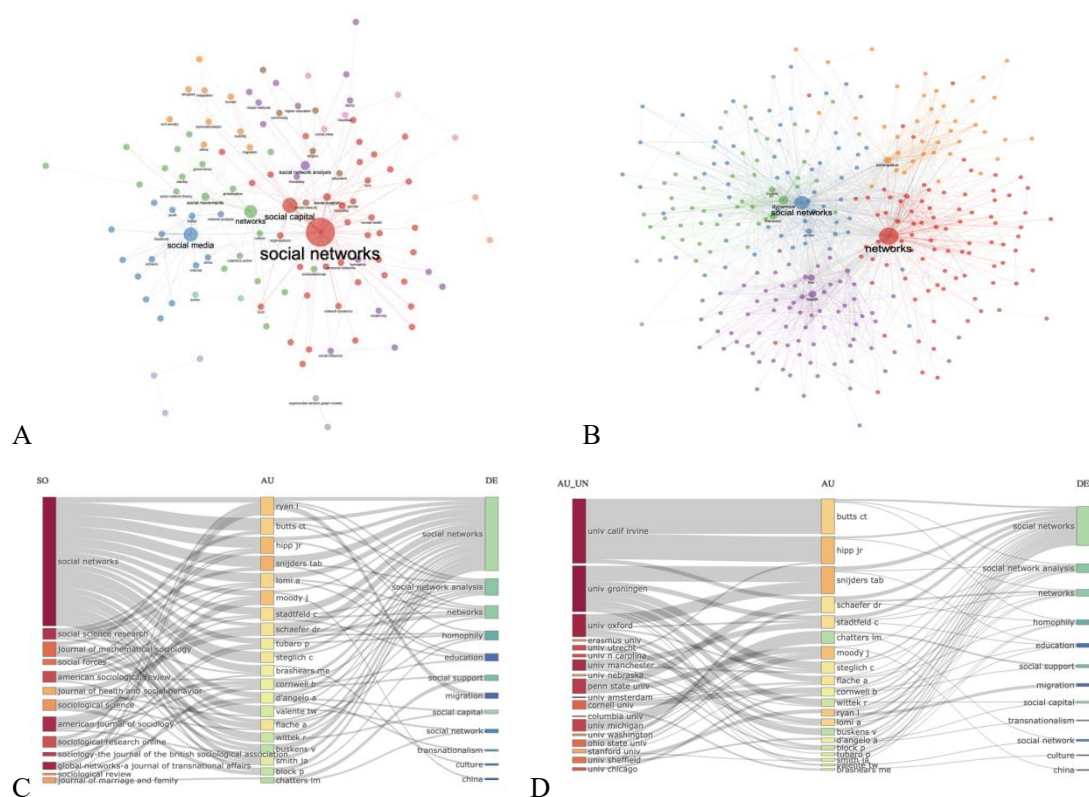


Fig. 8. (A) Co-occurrence of authors' keywords. (B) Co-occurrence of keywords plus. (C) Relationship among the authors, keywords, and journals. (D) Relationship among authors, keywords, and institutions.

3.5. Thematic map analysis

The thematic map, known as a strategic diagram, is a premeditated coordinate map for evaluating scientific research; it is employed to measure the development and mutual influence of research topics. The clusters were plotted in two-dimensional diagrams based on their centrality (x-axis) and density (y-axis) values. The four quadrants refer to niche, motor, emerging or declining, and basic themes. In this map, the different-colored bubbles correspond to the different themes that were associated with the same color. The size of the bubble refers to the frequency of the keywords (the larger the size, the greater the frequency of occurrence). Moreover, the bubbles were labeled by the three most frequent keywords in one cluster.

The thematic map of the authors' keywords is shown in Figure 9-A, revealing the correlation between the red bubble of social networks in the basic themes and potentially hot themes. However, within the basic development period, the green bubble of networks and the cluster of purple bubbles specifying the social network analysis of motor themes were relevant and well-developed themes. Moreover, the blue bubble of social media in the center of the map denotes the relatively developing themes. The yellow bubble of social networks and the pink bubble of the exponential random graph models were in the emerging or declining themes, indicating that these themes have either emerged recently or are currently declining. Nonetheless, the dark-yellow bubble of the actor-network theory in the niche themes was well-developed.

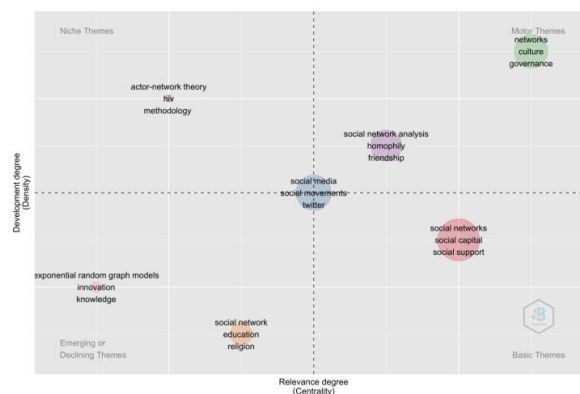


Fig. 9: Thematic map of authors' keywords that have occurred more than five times.

4. Discussion

4.1. Academic status and hot sociological field

The average growth rate of literature publications increased by 16.45% over the last 30 years, surging to the publication of over 100 articles annually since 2016. For all the articles that were published between 2001 and 2020, 75.69% experienced a rapid development period, demonstrating that the research on social networks developed well and exerts a future positive growth trend. The United States accounted for the largest publications (460 articles) and highest number of citations (26,161 citations); their SCP was also higher than MCP and the collaboration map, validating that the United States recorded high productivity regarding leadership, impact, academic creativity, and strong international cooperation. The United Kingdom and the Netherlands were also significantly productive and cooperative. Regarding institutional collaboration, the University of Groningen was the most productive, cooperating closely with the Universities of Oxford and Manchester, while the University of California Irvine prefers to independently accomplish the alternative route.

Based on the productivity, dynamics, h-index, and co-citation analyses, the most impactful journals were SN (228 articles), AJS (47 articles), and IC&S (67 articles). SN accounts for the core journal in this field. The dynamics of these journals inferred the well-developing trend in social networks. The co-citation analysis results demonstrated that the *American Journal of Sociology* (2630 citations), SN

(2257 citations), and ASR (2016 citations) were the most cited journals. According to the Journals' co-citation network analysis, the three most researched areas of social networks in sociology are, as follows: 1. longitudinal research on the social network itself; 2. combining social science, media science, and information communication for research; and 3. interdisciplinary research integrating health, behavior, medicine, and psychology. Snijders, Stadtfeld, Steglich, and Lomi of the University of Groningen account for the most productive authors who cooperated much more closely than the others and mainly focused on social network-related research. However, Lomi also focused on migration. Furthermore, the different institutions affiliated with the h-index indicated that Moody was academically active and greatly impacted this field. Hipp of the University of California Irvine cooperated with Butts to target social networks and networks.

The graph of the co-citation of documents demonstrates that Moody, Bennett, and Uzzi had the highest citations in social networks and strongly impacted other academic fields. The co-citation network of references confirmed that Granovetter and McPherson were pioneers who strongly impacted the previous research field of social networks. Granovetter researched how social networks applied to the micro and macro levels of sociological theory. Subsequently, Coleman, Putnam, Lin, and other researchers emphasized other research areas that were related to the concept (social capital, social resources, social structure, social support, and so on). Moreover, McPherson researched the effect of similarity on breeding connections, the homophily principle, as well as structuring network ties. Thereafter, Wasserman, Feld, Snijders, and other researchers extended the research to the applications, theory of social organization, and network dynamics.

The analysis of co-occurrence networks, thematic map, and conceptual structure map clustering by publications denote the trending topics and future directions in social network research. The keywords indicate that social networks are a well-developed hotspot for research. One part of the concept involves technology, community, refugees, culture, trust, and social support. The other relates to social class, higher education, and globalization. The thematic map verifies that the themes of social networks, social capital, and social support are significant for field research, although they are not yet well developed, offering a potential research direction in the future.

4.2. Research theories related to social networks

It was summarized the relevant theories of social networks in the sociological field tracked in this data set, which will provide a basis for the purpose of the future systematic study of social networks.

(1) Weak ties theory (Granovetter): it means that relationships contribute to the flow of information between different groups. Weak ties VS strong ties: the high homogeneity of the acquisition information repeatability is high (strong relationship), while the heterogeneity is the link between groups, the information acts as an information bridge (weak relationship).

(2) Embedding theory (Granovetter): economic behavior is embedded in the social structure, and the core social structure is the social network in which people live, the embedded network mechanism is trust, and the "embedding" theory implies the importance of connection.

(3) Social capital theory: the representative of Bourdieu, Coleman, Putnam and Lin. Social capital refers to the position and value of an individual in an organizational structure. The connected social capital, economic capital, cultural capital, and trust capital determine the size of the value.

(4) Social homophily principle (McPherson): similarity breeds connection. The homophily principle means structures network ties of every type, including marriage, friendship, work, advice, support, information transfer, exchange, membership, and other types of relationships.

(5) Structural hole theory (Burt): It emphasizes the structure and form of interpersonal networks and analyzes what kind of network structure can bring more benefits and rewards to the theme of network action. The position of individuals in the network is more important than the strength of the relationship, and its position in the network determines their information, resources, and power.

(6) Social network analysis (Wasserman): the methodology and application in the field of social

network analysis, and its application in social and behavioral science. The social network perspective mainly focuses on the relationships between social entities.

4.3. Future themes related to social networks

Social capital in the co-occurrence network and thematic map signifies that it is also a highly frequent keyword that is related to social networks. Overall, 162 social capital-related articles were obtained, accounting for over 10% of the total publications in this database. This number has increased exponentially with the development of social networks as a discipline. Social settings generate social networks and are influenced by them (Feld 1981; Pattison and Robins 2006). Bourdieu elaborated the concept of social capital (Harrison 2011), defining it as containing all the structural resources of individuals (Coleman 1990). Putnam noted that the most integral factor resulting in the decline of social capital is the replacement of generations (Putnam 2000). Studying social capital, Lin (2001) revealed the significance of the concept of social resources. Since social capital is related to the effective development of society, existing research on the elderly, as it relates to social capital involves individual-based themes, such as health, depression, loneliness, well-being, mental health, life satisfaction, leisure education, economic hardship, and social contacts, as well as the group-based themes of social networks, such as formation, family, neighborhood, rural, urban, and functional ability (Bai 2021; Gu 2021; Jiang 2020; Lager 2015; Zhong 2017). Further, it covers a range of countries, including China, Russia, Iran, Singapore, Canada, Australia, and Korea.

Social support, as a relatively high-frequency keyword, has attracted great attention from researchers. In the literature, a social support network is recognized as an interesting research direction for the elderly. It is also involved in a variety of themes, such as the social support network questionnaire, urban–rural comparative study in China, life satisfaction, depression, dementia, race difference, loneliness, diabetes control, and health (Lin 1999;). It also covers a range of countries, such as China, South Korea, Chile, Singapore, Spain, and Mexico (Tang, 2019, 2020).

The application of social capital and social support to the social networks of the elderly has also begun to attract much attention globally. Therefore, the analysis of social networks is inseparable from a clear definition of the concept of social capital and social support. Social support is a perceived and practical instrumental or expressive line of support provided by the community, social networks, and intimate partners. Social support network refers to the process of individuals seeking help. Its essence is the process of obtaining social resources by mobilizing direct or indirect social network relationships. Therefore, it will be of great significance for future research to clearly define the concepts of social networks, social resources, and social support, and to integrate the concepts to apply them in sociological research.

5. Conclusions

The findings of this study indicate a rapid and continuous development of social networks over the past 10 years. Moreover, the United States is the largest contributor to social networks, and publications from the United States, the United Kingdom, and the Netherlands account for more than 65% of the total number of published research papers. The Universities of California Irvine and Groningen accounted for the institutions with the highest yields and greatest impacts in this area. Most relevant studies published in social network journals indicate that social network is an important and significant field. The data demonstrates that the most prolific authors are largely based on cross-institutional and transnational collaboration and have a strong impact on the field. In particular, Snijders was the most productive author with the highest h-index, while Moody was active and productive ,significantly influencing the filed of social networks and beyond. This study predicts that social networks based subjects, as well as the combination of social capital and social support, offer viable future research directions that are especially applicable to studying the living status of the elderly. This study will enable researchers to fully understand the global academic performance, development status, and trends of social networks, which can guide future research in this field.

In this study, a bibliometric analysis was conducted to create a literature dataset to examine the research trends in social networks; quantitatively and qualitatively analyzes of the results were also conducted. However, regarding the limitations of this study, the data were only retrieved from WoS, and since the papers that are selected for WoS are in English, social networks papers in the Chinese database that have high reference values were not included. Moreover, recently published articles were poorly cited, and their contributions to this field were probably underestimated. The results of this analysis might have been affected by conditional selection. In future studies, the authors would consider additional literature sources, such as PubMed and Scopus, together with relevant Chinese literature. For the data visualization parameters selected in this study, because there is no standard parameter reference, the data parameters are selected for the comprehensive advance literature, and the visual image remains to be discussed. A more reasonable parameter choice needs to be considered in the future analysis.

Research on social networks started early and grew rapidly worldwide. Social networks focus on the field of sociology: longitudinal research; combination of social science, media science, and information communication for research; and interdisciplinary research integrating health, behavior, medicine, and psychology. The main theories are mainly: Weak ties theory and Embedding theory, Social capital theory, Social homophily principle, Structural hole theory, and so on. The main research topics are social networks, social capital, and social support. The research findings in this paper summarise the academic performance of social networks in the field of sociology in the past 30 years, and provide quantitative evidence, theoretical support, and hot topics for future sociological research.

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