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Original Research

Social Network Analysis of Editorial Board Interlocking phenomena from the perspective of astronomy and astrophysics journals

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Abstract

Editorial board members (EBMs) of journals play a pivotal role in authentic international scientific journals. Editorial Board Interlocking (EBI) phenomenon reflects the effectiveness and importance of the scholarly journal's editorial boards in various scientific fields. The primary purpose of this paper is to conduct a Social Network Analysis (SNA) of EBI phenomena from the perspective of astronomy and astrophysics journals. The present study is applied research based on EBI, SNA, and the descriptive-analytical approach. The statistical population of this study consists of the editorial board members of all journals of astronomy and astrophysics indexed in the JCR and official journal websites. There are 1597 job positions in 67 astronomy and astrophysics journals occupied by the 1394 scholars. Data analysis shows EBI for 95 scholars and 79 organizations. "Aleksei A. Starobinsky" from Russia and the Russian Academy of Sciences, "Daniel J. Scheeres" from the United States, and the University of Colorado Boulder have the highest EBI contributions in five journals. "Daniel J. Scheeres," with a centrality of 39, has the highest degree of centrality measurement among the EBMs. The presence of more than five times as many men as women indicates that astronomy and astrophysics journals are considered "masculine" by the editorial board. The EBI phenomenon is observed in astronomy and astrophysics journals due to the limited number of peop le eligible for the editorial board. Due to EBI, a limited number of famous scholars are made macro-policies such as publishing the articles, referees selections, and the reviewing process. Astronomy and astrophysics journals have "elite" academic networks. Gender inequality exists among EBMs, and the majority of them are male. Accordingly, these journals are "men's journals."

Keywords: Editorial Board Interlocking (EBI). Scientometrics. Social Network Analysis (SNA). Centrality measurements. Astronomy and Astrophysics. Editorial Board Members (EBMs).

Introduction

Scientific journals are essential for developing scientific knowledge and communication (Liwei & Chunlin, 2015; Braun, 2004). Editorial Board Members (EBMs) of scientific journals illuminate the evolution process and quality standards and define the criteria for evaluating submitted articles through policy-making (Baccini, Barabesi & Marcheselli, 2009; Braun, 2004; Liwei & Chunlin, 2015). They also show prevalent, desirable topics, theories, and future methodologies by accepting articles for publication. Most EBMs are elite researchers endorsed in their respective specialized research fields and are well-known in the academic community (Liwei & Chunlin, 2015) with positive impacts on research fields. They consider high-level criteria for reviewing articles submitted to journals and expect their colleagues to use the same criteria in future research. The relative scarcity of elites has led them to cooperate as EBMs in several scientific journals. This phenomenon is called Editorial Board Interlocking (EBI), which creates a social network of EBMs in scientific journals (Baccini, et al., 2009; Baccini & Barabesi, 2011; Liwei & Chunlin, 2015). Social Network Analysis (SNA) is used to study scholarly communication patterns in various scientific fields (Scott, 2000; Freeman, 1979 & 2006). SNA is also often used in studies on social structures (Rousseau & Zhang, 2008). A social network is a set of individuals/groups with connections to others or the entire network, and their connections are called nodes (Newman, 2000; Scott, 1991).

People are often interested in identifying the most prominent factor(s) in a network. Therefore, centrality is located at the center of many connections; it is a factor with many direct links to other factors. Centrality is commonly used to identify potent, influential, and vital factors (Carrington, Scott & Wasserman, 2005; Yasmin, Edward, Walid & John, 2008). Centrality measures are the most important and extensively used metrics and determinant parameters for analyzing actors' roles in social networks (Newman, 2005). Degree centrality usually reflects reputation and relational activity, which calculates the number of connections of a person with other people on the network (Cheng, 2006). Closeness centrality measures an individual's distance from all other people on the network, in which the closer a person is to others, he/she is more famous and selected (Cheng, 2006). Betweenness centrality identifies the position of a node within a network in terms of its ability to communicate with others (Cheng, 2006). Betweenness centrality is a widely used measure that captures a person's role in allowing information to pass from one part of the network to another (Golbeck, 2015).

EBI analysis can also be considered a fundamental approach to understanding how scientific journals affect academic environments and scientists. Undoubtedly, EBMs are the leading and most important component of scientific journals that play a significant and decisive role from establishing journals and selection as EBMs until the publication of journals and finally indexing journals in the international citation database (Willett, 2013). Therefore, identification and determination of the presence and effectiveness of EBMs in international journals and evaluation of their levels of collaboration and presence in various journals (EBI phenomenon) is an issues that should be considered challenging by policymakers and planners. This issue has been addressed in the present study.

Another present research problem is the limited number of powerful and well-known scientists with key and influential roles in various subject areas. Social networks are formed through connections between them and other top scientists. Analyzing these social networks provides valuable information for planning, managing, and predicting strategic objectives (Soheili & Osareh, 2013; Teixeira & Oliveria, 2018).

Due to the limited number of popular and elite, these individuals collaborate in more than one journal as EBMs. This limitation in the number of scientists and researchers eligible to join the EBMs of journals has exposed the publishing world to an EBI phenomenon. Preliminary evidence indicates that journals of astronomy and astrophysics also face this phenomenon.

The EBI phenomenon has emerged in journals because of the importance of peer-reviewed journals, the unique role of EBMs, and their presence in more than one journal. The main problem of this research is the investigation of various aspects of one of the critical and strategic subject areas (Astronomy & Astrophysics), the discovery of multiple connections between EBMs, and the analysis of the EBI phenomenon using SNA. In addition to the primary research problem, the analysis of all EBMs of all astronomy and astrophysics journals included in the Journal Citation Report (JCR) in 2018 based on gender, nationality, affiliation, and academic rank is another fundamental problem addressed in the present study.

EBI leads the scientific communications and future roadmap of those journals to be significantly influenced by these individuals and phenomena. In this regard, the EBI phenomenon must be studied to determine how and to what extent journals are influential (Teixeira & Oleveira, 2018). The main objective of EBMs is to publish high-quality articles (Cabanac, 2012). EBMs must perform many tasks in the best possible way, including formulating macro-policies, selecting and preparing a database of reviewers with various specializations following the subject area of the journal, and finally making the final decision on the reviewed articles to achieve their objectives (Bruan, 2004; Baccini & Barabesi, 2009; Baccini, Barabesi & Marcheselli, 2009; Hames, 2001, 2007; Liwei & Chunlin, 2015; Andrikopoulos & Economou, 2015; Braun & Dióspatonyi, 2005a, 2005b).

EBMs' perspectives and suggestions form and pave the way for the development of academic research by influencing the selection of research topics and theoretical and methodological foundations. EBMs play a crucial role in the evolution of research fields and paradigms of that discipline through their activities (Serenko & Bontis, 2017; Hames, 2007). Peer-reviewed is a system in which the evaluation and selection of academic research is conducted (Braun, 2004). EBMs are the gatekeepers of knowledge and the influencers of academic discourse (Wang, 2018). The main objective of peer-reviewed journals is to select renowned researchers as EBMs who are experts in their field of research and approved by the international scientific community (Goyanes & De-Marcos, 2020; Andrikopoulos & Economou, 2015; Baccini & Barabesi, 2009, 2011; García-Carpintero, Granadino & Plaza, 2010; Braun & Dióspatonyi, 2005a). As mentioned, authentic peer-reviewed journals encounter limitations in selecting EBMs, which leads them to employ scientists who serve as EBMs in others in the same subject area, known as EBI. EBI occurs when an EBM appears in more than one scientific journal (Baccini & Barabesi, 2009, 2011; Liwei & Chunlin, 2015).

It seems that studying such a phenomenon in journals of different scientific domains seems required. In other words, research policymakers and chief editors must be familiar with this important phenomenon and its functions. EBI visualization with SNA and clarification of the EBI status of different disciplines are essential. The study of this phenomenon in journals of various subject areas and the study of the relationship between EBI and other journal evaluation indicators, such as Impact Factor (IF), number of citations, and Quartile (Q), is of great importance and can open new horizons for policymakers in the field of publishing peer-reviewed journals and organizations and research centers related to ranking and indexing of journals.

Objectives

The primary purpose of this paper is Social Network Analysis (SNA) of EBI phenomena from the perspective of astronomy and astrophysics journals. In line with the primary objective, the following questions must be answered:

- *RQ1*. Which journals and EBMs of Astronomy and Astrophysics have the highest EBI?
- *RQ2*. How are the frequency distribution and percentage of academic rank and gender of EBMs with EBI?

- *RQ3*. How are the degree, closeness, and betweenness centralities of each member of the EBMs of astronomy and astrophysics journals?
- *RQ4*. How is the EBM network with EBI by the use of SNA?

Literature Review

A literature review indicates that few studies have analyzed the EBI phenomenon in different subject areas in recent years. These studies investigated the EBI phenomenon using different methodologies and indicators from different perspectives. SNA and centrality indicators were used in these methodologies. A small number of studies have used network analysis to analyze the EBI phenomenon and the connections between journals (Baccini, 2009; Baccini et al., 2009; Baccini & Barabesi, 2009; Ni & Ding, 2010; Andrikopoulos & Economou, 2015; Goyanes & De-Marcos, 2020). Moreover, few studies have applied SNA and centrality indicators to analyze the EBI phenomenon (Baccini, 2009; Teixeira & Oliveira, 2018). These researchers believe that SNA helps assess the structure and EBI and provides a coherent knowledge of the EBI phenomenon. for determining the centrality of individuals on social networks, Freeman's measurements of degree, closeness, and betweenness centralities were the most extensively used measures (Freeman, 1979). Newman studied various characteristics of these networks, including the degree of scientists and their betweenness (Newman, 2001). The background related to the EBI phenomenon is reviewed below.

Baccini (2009) first studied the EBI phenomenon in Italian journals in economics using the SNA approach. The results showed a significant similarity between the policies, programs, review policy, and final rejection or acceptance of articles submitted to journals with EBMs employed in several other journals as EBMs or editors. Baccini et al. (2009) reviewed statistics and probability journals using the SNA method in another paper. They believe that those journals will follow the same policies if EBMs collaborate and are involved in more than one journal. The results of this study also found that the network created by the EBI has a high density. In the same year, Baccini and Barabesi (2009) analyzed a network of 124 journals on economics. Similar to their previous article, they hypothesized that if EBMs of a peer-reviewed journal collaborate in two or more peer-reviewed journals as EBMs or chief editors, the policies and guidelines of these journals would be significantly similar. Therefore, it can be stated that these two Italian researchers were the first to publish an article on EBI. The results of the centrality indicator show that the more relevant a journal is to other journals, the more pivotal its position in the network.

Following previous research, Metz and Harzing (2009) assessed the gender diversity of EBMs in management journals. Their research population consisted of women on the editorial board of 57 management journals from 1989 to 2009. The statistical population included women who had authorship in the studied journals and were editorial board members. The results revealed that the women as EBMs did not publish an article in the studied journals as the corresponding Authors, and the three factors of the field of study, the journal credibility, and the editor's gender were involved in this issue. Gender inequality in EBMs of some management journals during the study period prevented women from expressing their ability to achieve scientific knowledge and progress. Certainly, this has affected research in the field of management. Following the reviewed research, Baccini and Barabesi (2011) studied the EBI phenomenon of 61 journals in library and information sciences using SNA. They analyzed the occupations of the EBMs in three groups: chief editor, associate editor, and editorial board member. The results showed that there are 2003 positions in the journals, of which 1752 people are employed. The average number of job positions for each journal is 32.8, and the average number for EBMs is 1.14 for journals in library and information sciences (LISs). They believe that researchers will have common elements in their policies if they collaborate with the editorial boards of the two journals.

Ni and Ding (2010) also analyzed 58 journals in LISs using data extracted from the EBI phenomenon and applied methods such as factor analysis, hierarchical clustering, and multidimensional scaling. Data analysis showed that the EBMs of ten journals did not cooperate with any other journals. Moreover, approximately 90% of EBMs in journals on LISs work in only one similar journal, and the EBI phenomenon in those journals is quite apparent. In addition, Burgess and Shaw (2010) studied the SNAs of management and business journals by assessing their EBMs. Their research population comprised 36 top journals on the Financial Times list and 2952 EBMs, including 2405 individuals, 512 organizations, and 45 countries. The results of their research indicated that the top positions of EBMs in journals belong to American-affiliated universities and high-level American organizations. The EBMs studied were predominantly male and from North America. Gender inequality and discrimination are evident in the type of organization and country in which individuals are EBM and the appointment of women to this position. The observed bias casts doubt on meritocracy in the selection process and membership in the editorial boards of journals. The editorial board job, which includes the concepts of designation and journal, can make a big difference in persuasion.

Chan, Fung and Lai (2005) have stated that any country with the most significant number of EBMs in specialized journals will dominate that domain. The present study found that the most important number of EBMs in astronomy and astrophysics journals are from the United States. Metz and Harzing (2012) studied the gender diversity of EBMs in management journals for over two decades. They expanded their previous study with the same title and reviewed 57 management journals from 1989 to 2004. The results showed that the presence of women as EBMs, associate editors, and senior editors reached 22.4%. Despite such a positive pattern in this investigation, the presence of women as EBMs has become more limited in five managerial areas, four journal rankings, and two geographical regions. The results also showed gender inequality in the editorial boards of management journals.

In another study, Liwei and Chunlin (2015) analyzed the social network and performance of EBMs in 23 library and information sciences journals. They applied the Chinese Science Citation Database to select journals. Among the journals reviewed, Library & Information Service had the largest number of members with 56 EBMs. The co-occurrence matrix was plotted to study the EBI, and UCINET was used for the SNA. Data analysis indicated that EBMs in China are not fully committed to being a member of the editorial board of journals because of the part-time cooperation, the old age of members, and the cooperation in several journals. In line with the previous article, Andrikopoulos and Economou (2015) evaluated the EBMs of 20 leading journals in economics between 1994 and 2003. They analyzed the social structure of EBMs, their responsibilities, their nationality, and the affiliations of the research population. This research was conducted at three levels: individual, organizational, and national. The results revealed that elites are effective in macroeconomic policy-making and publishing materials' content.

Furthermore, the dispersion patterns of the EBMs of journals are national. In addition, the network analysis results showed that the nodes at the network core were the EBMs of the journals. They share common interests and values and influence the scientific process and policy of EBMs.

Erfanmanesh and Morovati (2017) introduced the EBI phenomenon in a study emphasizing the crucial role of journal editors and EBMs in determining the future direction of scientific disciplines and the impact of their thinking on scientific communication through decisions and their reflections in scientific journals. The population of this study was 518 journals in the humanities and social sciences of the Ministry of Science, Research, and Technology of Iran. The results showed that 2573 people were employed in 5188 positions of EBMs (an average of ten members in each journal). Moreover, 1513 people (58.8%) were EBMs in one journal, 431 people (16.8%) were EBMs in two journals, and 248 people (9.6%) were EBMs in three journals. Thirteen researchers collaborated in ten or more journals as EBMs. In another study by Teixeira and Oliveira (2018), the EBIs of 27 journals on Knowledge Management and Intellectual Capital (KM–IC) were evaluated using the SNA method and centrality measurements. The findings revealed that 1178 EBMs work in 1295 positions of the EBMs of journals. The maximum and minimum numbers of EBMs in a journal were 148 and 4, respectively. EBI was observed in 25 journals. Finally, an invisible college was identified in the KM-IC. The techniques used to identify coherent subgroups indicate a set of four journals classified both in KM–IC rankings and in the centrality measurements, with a strong correlation between them.

In another article entitled "Academic influence and invisible colleges through EBI in communication sciences: a SNA of leading journals," published by Goyanes & De-Marcos (2020), EBI of 41 Q1 and Q2 Journals of communication was analyzed. The Network X package from Python and Gephi, graph theory, and SNA were used in this study. The results showed a total of 2097 nodes, of which 2056 nodes belonged to EBMs and 41 nodes belonged to journals. The findings also revealed that 37.26% of the statistical population were female, 60.65% were male, and 2.09% did not specify their gender. Moreover, most EBMs are from the United States, the United Kingdom, and other European countries. Lockstone-Binney, Ong and Mair (2021) also examined the emerging phenomenon of "interlocking editorship" with a mixed-methods study with a qualitative study among tourism journal editorial boards. Their research indicates that the editorial structure of the journals under study is highly concentrated and homogenous and that most appointments are made at the male and professorial levels. Also, the editorial board of tourism magazines is primarily male.

The literature review showed that researchers studied the EBMs and the EBI phenomenon. However, they implemented a single approach in different statistical populations with other quantitative methods and tools in various datasets. Furthermore, the statistical populations of the reviewed literature were related to social sciences and humanities, such as finance, LIS, and KM–IC. Therefore, the literature was not observed for the statistical population, including the basic sciences, engineering, medical sciences, and veterinary, agriculture, and art and architecture journals. Moreover, some papers were geographically limited to countries, regions, or limited periods. The present article is the first to analyze astronomy and astrophysics journals. In addition, it has no temporal or geographical limitations. Furthermore, data collection and analysis methods and the software used in this study are significantly different from previous literature regarding the diversity of applied variables. Therefore, conducting this research is necessary with the innovations mentioned above.

Materials and Methods

This research was applied using the EBI phenomenon (Andrikopoulos & Economou, 2015; Baccini & Barabesi, 2009, 2011; Liwei & Chunlin, 2015; Goyanes & De-Marcos, 2020), SNA, and a descriptive-analytical approach. Comprehensive data on the implementation steps of the research are provided in Table 1; four steps of selecting the research population, data collection and preprocessing, data analysis, and data visualization were introduced as the implementation steps of this study. The tools and software required for each step are shown in the second column of the table.

Table 1
Steps, tools, software, and limitations for the present research

Steps	Tools and software required at each step	Description
Selecting Research Population	• JCR (2018)[1] • Journals' official websites	• Review of English language journals of astronomy and astrophysics using JCR 2018. • Journals that did not have an official website and data about the journal's EBMs could not be retrieved, such as the "OBSERVATORY" were removed. • "BALTIC ASTRONOMY" has been renamed to "OPEN ASTRONOMY" and now has an official website with a new name, and the details of the editorial board can be retrieved on the new website. • The data of the EBMs of 67 journals of astronomy and astrophysics were extracted and collected. In these 67 journals, there are 1597 editorial positions registered, and 1394 scholars occupied these positions. • All information on the EBMs of astronomy and astrophysics was collected.
Data Collection and preprocessing	• JCR (2018) • Excel • Journals' official websites • Google Scholar • Research Gate • LinkedIn • Personal Websites • Organizational Websites	• The list of astronomy and astrophysics journal was downloaded using JCR. • The journals' names and ISSN were searched in Google and Google Scholar to retrieve the journals' official website, and the URLs of all the journals were entered in an Excel spreadsheet. • For each journal, a sheet with the name of that journal was created in Excel. Data related to each EBM, including name, gender, nationality, affiliation, academic rank, and individual responsibility in the journal, were inputted. • Data collection is all the scholars whose names are listed as the journal's EBMs on the journal's official website. • The official website of journals, resume reviews, personal website reviews, profiles from social networks such as Research Gate, LinkedIn, Google Scholar, the dedicated page of these people in specialized and international associations, and the official website was searched. • In the present study, to determine the gender of the EBMs, various methods were used, such as image search of an EBM's name in Google, Curriculum vitae review, personal website review, the search of social networks profiles, and official website (Ashmos Plowman and Smith, 2011; Williams, Kolek, Saunders, Remaly & Wells, 2018). Finally, in most studies where gender is one of the main variables, the gender of a percentage of the research community is not always recognizable by any of the above methods and is excluded from the research population. For example, in a recently published study, 373 people (equivalent to 7%) were excluded from the study population of 4,973 due to the lack of gender recognition (Nunkoo, Thelwall, Ladsawut & Goolaup, 2020). A similar problem was also observed in Metz and Harzing (2012) • In the present study, the positions related to journals were also registered into three categories: chief editor, associate editor, and editorial board member. A look at the data collection section of previous research showed that it is better to limit these positions during data collection, which prevents the dispersion of jobs during the data collection (Teixeira and Oliveira, 2018). • The data of 1394 scholars were collected using the mentioned methods.

[1] The data for this article was collected in July 2019, and it was not possible to use JCR 2020. However, a comparison with the JCR 2018 astronomy and astrophysics journals with JCR 2020 indicates that there is very little difference between the two JCR editions in the present research population, which has no significant effect on the results of this paper.

Steps	Tools and software required at each step	Description
		• Preprocessing and unifying the data like names, journals, institutions, and countries. • The Census method was used to collect data. • The normality of the data was performed using the Kolmogorov-Smirnov test (Mishra, Pandey, Singh, Gupta, Sahu & Keshri, 2019). • Descriptive and inferential statistics, including frequency distribution and percentage, were used to analyze the data.
Data Analysis	• Excel • Pajek • ExcelToPajek • Python	• Analysis of descriptive data and reporting this data in the form of tables and graphs in Excel • Establishment of a matrix of EBMs and journals with EBI using Pajek and Excel To Pajek • Excel file data was converted to .net files, and the initial matrices were designed • Provision of an algorithm in Python to ensure the results of the previous step • Preparation of a binary matrix to adjust interlocking tables and drawing a network map using Python • All the scholars who are present in each journal as EBMs were identified. Then, those individuals, who were present in only one journal and did not create a network interlocking in other journals, were extracted as unique individuals and excluded from the research population.
	• UCINET • Net Draw •	• Analysis of EBI phenomenon by SNA method • Calculation of indicators of degree, closeness, and betweenness centralities and drawing the maps related to EBMs and journals with EBI using Net Draw and UCINET
Data Visualization	• SPSS • Pajek • Net Draw	• Data visualization of social networks using SPSS, Pajek (Nooy, Mrvar & Batagelj, 2005), Excel, UCINET (Borgatti, Everett & Freeman, 2002; Borgatti 2002), and Net Draw (Borgatti 2002)
Limitations & Solutions		• Finding the first name and gender of the people were two of the research limitations that led to a significantly time-consuming process for the researcher during data collection, which sometimes took hours to obtain this data. Since all the present study data were extracted manually, all the collected data were re-controlled to ensure the accuracy of the data. Therefore, in addition to extracting this volume of data, re-controlling the data required a great deal of energy and time. In order to overcome these restrictions, it is recommended that journals put the full name and photo of EBMs on the official websites. • Many EBMs used acronyms, terms, and uncommon phrases, sometimes in languages other than English, for their job title, academic rank, or the organization's name in which they are employed, which resulted in problems with the software during the data analysis. Therefore, we preprocessed, unified, and refined all the data before statistical analysis.

SNA was used to visualize the interlocking of EBMs and journals in the statistical population of the research. SNA is a set of approaches that can evaluate the connections or nodes between two or three factors or all factors and is considered to be the study of social relationships between a set of factors (Wasserman & Faust, 1994; Cheng, 2006). The present study used degree, closeness, and betweenness centrality measurements. Degree centrality is measured by counting the number of nodes or links entering or exiting a particular node. A factor with the most links has the highest rank and is, therefore, the most central node (Cheng, 2006; Freeman, 1979, 1978). Closeness centrality measures an individual's distance from everyone else in the network. The closer an individual is to others, the more selective and famous the individual is. Individuals with higher closeness centrality are more likely to receive information faster than others in the network. Closeness centrality is the diversity of the shortest paths between each individual and the others in the network (Wasserman and Faust, 1994; Wasserman and Galaskiewicz, 1994). This indicator is calculated based on distance (Geodesic) and measures the distance of one node from other nodes (Parise, 2007; Cross & Prusak, 2002; Parise, Cross, & Davenport, 2006). Betweenness centrality identifies the position of an entity within a network based on its ability to communicate with other groups. This indicator is a mediating indicator through which the connection channels of other points pass, and these points have the power to isolate or increase the connections (Borgatti, 2005).

Results

A 2 × 2 matrix was applied to set the EBI tables and network maps. First, all scholars collaborating in each journal as EBM were identified using Python. Then, the scholars present in a journal had no EBI and were removed from the dataset. In other words, only data from EBI were analyzed. The individuals, journals, organizations, and countries, the data of which are described below, exhibited the EBI phenomenon.

Astronomy and Astrophysics journals with the highest amount of EBI

Forty-six (46) journals out of sixty-seven (67) journals of the research population had EBM interlocking; the journals with the most EBM interlocking are presented in the following table based on frequency distribution and percentage. "Astrophysical Journal Letters," "Astronomical Journal," "Astrophysical Journal," and "Astrophysical Journal Supplement Series" have the highest EBI with 37 (13.1%) frequencies. All four mentioned journals are Q1, and their IFs are 8.374, 5.497, 5.58, and 8.311, respectively (Table 2).

Table 2
Frequency distribution and percentage of astronomy and astrophysics journals with the highest amount of EBI

Rank	Journal Name	Freq.	%	IF	Q
1	Astrophysical Journal Letters	37	13.1	8.374	Q1
2	Astronomical Journal	37	13.1	5.497	Q1
3	Astrophysical Journal	37	13.1	5.58	Q1
4	Astrophysical Journal Supplement Series	37	13.1	8.311	Q1
5	Universe	24	8.5	2.165	Q2
6	International Journal of Modern Physics D	14	5	2.004	Q3
7	Modern Physics Letters A	9	3.2	1.367	Q3
8	Gravitation and Cosmology	9	3.2	0.676	Q4
9	Journal of Cosmology and Astroparticle Physics	8	2.8	5.524	Q1

Editorial board members (EBMs) with the highest amount of EBI

Data analysis indicates that 1394 scholars of a unique editorial board are employed in 635 organizations (universities and research institutes). According to the extracted data, organizations with interlocking can also be identified. The frequency distribution and percentage of EBMs and organizations with interlocking are presented in Table 3. There were 95 EBMs in the 79 organizations. Table 3 shows the data with frequencies of 5 and 4.

Table 3
Frequency distribution and Percentage of EBMs with the highest amount of EBI

NO.	Name/ Family name	Academic Rank	Country	Organization	Freq.	%
1	Aleksei A. Starobinsky	Professor	Russia	Russian Academy of Sciences	5	1.8
2	Daniel J. Scheeres	Professor	United States	University of Colorado Boulder	5	1.8
3	Luis C. Ho	Professor	China	Peking University	5	1.8
4	Allen W. Shafter	Professor	United States	San Diego State University	4	1.4
5	Ata Sarajedini	Professor	United States	Florida Atlantic University	4	1.4
6	August Muench	Professor	United States	Harvard University	4	1.4
7	Bożena Czerny	Professor	Poland	Polish Academy of Sciences	4	1.4
8	Brad Gibson	Professor	United Kingdom	University of Hull	4	1.4
9	Brian Jackson	Associate Professor	United States	Boise State University	4	1.4
10	Butler Burton	Emeritus	Netherlands	Leiden University	4	1.4
11	Carraro Giovanni	Professor	Italy	University of Padua	4	1.4
12	Chris Lintott	Professor	United Kingdom	University of Oxford	4	1.4
13	Christopher Conselice	Professor	United Kingdom	University of Nottingham	4	1.4
14	Daniel W. Savin	Senior Researcher	United States	Columbia University	4	1.4
15	Dieter H. Hartmann	Professor	United States	Clemson University	4	1.4
16	Edgard G. Rivera-Valentín	Senior Researcher	United States	Universities Space Research Association	4	1.4
17	Elias C. Vagenas	Professor	Kuwait	Kuwait University	4	1.4
18	Eric D. Feigelson	Professor	United States	Pennsylvania State University	4	1.4
19	Ethan Vishniac	Professor	United States	Johns Hopkins University	4	1.4
20	Fabian Walter	Professor	Germany	Max Planck Institute for Astronomy	4	1.4
21	Faith Vilas	Senior Researcher	United States	Planetary Science Institute	4	1.4
22	Frank Timmes	Professor	United States	Arizona State University	4	1.4
23	Frederic Rasio	Professor	United States	Northwestern University	4	1.4
24	Gary Zank	Professor	United States	University of Alabama	4	1.4
25	Gennady S. Bisnovatyi Kogan	Professor	Russia	Russian Academy of Sciences	4	1.4

NO.	Name/ Family name	Academic Rank	Country	Organization	Freq.	%
26	Greg J. Schwarz	Emeritus	United States	Arizona State University	4	1.4
27	Gregory J. Herczeg	Professor	China	Peking University	4	1.4
28	Joan M. Wrobel	Professor	United States	National Radio Astronomy Observatory	4	1.4
29	Judith Pipher	Emeritus	United States	University of Rochester	4	1.4
30	Lee Armus	Senior Researcher	United States	Infrared Processing and Analysis Center	4	1.4
31	Leon Golub	Senior Researcher	United States	Harvard University	4	1.4
32	Luigi Stella	Professor	Italy	Astronomical Observatory of Rome	4	1.4
33	Manolis K. Georgoulis	Senior Researcher	Greece	Academy of Athens	4	1.4
34	Maria Womack	Professor	United States	University of Central Florida	4	1.4
35	Michael Endl	lecturer	United States	University of Texas at Austin	4	1.4
36	Rekha Jain	Professor	United Kingdom	University of Sheffield	4	1.4
37	Shadia Habbal	Professor	United States	University of Hawaii	4	1.4
38	Steinn Sigurdsson	Professor	United States	Pennsylvania State University	4	1.4
39	Steven Kawaler	Professor	United States	Iowa State University	4	1.4
40	Steven M. Crawford	Senior Researcher	United States	Space Telescope Science Institute	4	1.4

"Aleksei A. Starobinsky," "Daniel J. Scheeres," and "Luis C. Ho" have the highest EBI. Each of these scholars collaborated with five journals as EBMSs. "Aleksei A. Starobinsky" works at the Russian Academy of Sciences. "Daniel J. Scheeres" is an American researcher who teaches at the University of Colorado Boulder. "Luis C. Ho" is also at Peking University. All three people had the same academic rank as professors.

Academic Rank of EBMs with EBI

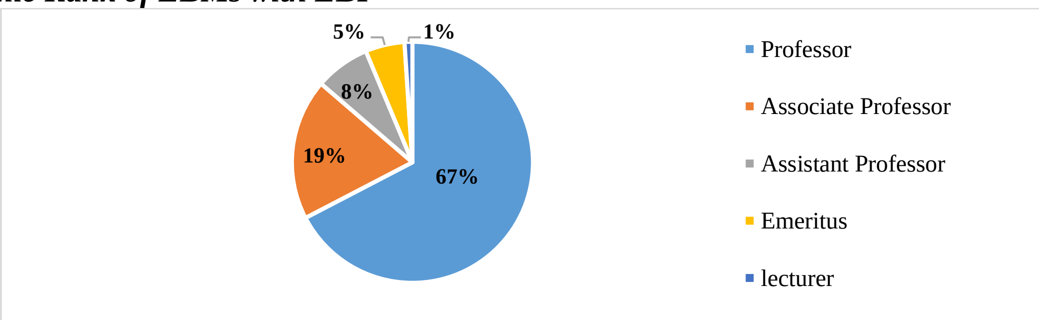

Figure 1: Percentage of EBMs' Academic rank with EBI

The data in Figure 1 indicate that most of the EBMs with interlocking are professors (67%). In addition, 19% of EBMs in astronomy and astrophysics journals are associate professors. The academic rank of lecturers also has the lowest contribution among EBMs in the journals of the research population (1 %).

Academic Rank of EBMs with EBI by gender

Table 4

Frequency distribution and percentage of Academic rank of EBMs with EBI by gender

Rank	Academic Rank	Total		Men		women	
		%	Freq.	%	Freq.	%	Freq.
1	Professor	67	64	71	55	53	9
2	Associate Professor	19	18	18	14	24	4
3	Assistant Professor	8	7	5	4	18	3
4	Emeritus	5	5	5	4	6	1
5	Lecturer	1	1	1	1	0	0
Total		100	95	100	78	100	17

The data analysis in Table 4 shows that the research population consisted of 78 men and 17 women as EBMs of journals with the EBI phenomenon. The EBMs with the academic rank of professor had the highest frequency among men (64) and women (9). In comparison, the lowest frequency was assigned to the academic rank of lecturers among men (1) and women (0) among EBMs. The data analysis in Table 4 shows that the frequency of men with different academic ranks is 4.5 times higher than that of women; that is, 17.89% of women and 82.11% of men are EBMs of astronomy and astrophysics journals with EBI.

EBMs Centrality Indicators with the highest EBI

Table 5

Centrality Indicators of EBMs

No	Name/Family name	Abbreviate name	Degree	Closeness	Betweenness
1	Aleksei A. Starobinsky	A.A.Starobinsky	27	316	59.593
2	Alessandro Morbidelli	A.Morbidelli	3	295	0
3	Alexander F. Zakharov	A.F.Zakharov	25	241	1013.5
4	Allen W. Shafter	A.W.Shafter	36	311	0
5	Anatol M. Cherepashchuk	A.M.Cherepashchuk	3	366	0.5
6	Anna Milillo	A.Milillo	25	242	968
7	Anne Green	A.Green	14	332	14.002
8	Anzhong Wang	A.Wang	31	275	64.222
9	Ata Sarajedini	A.Sarajedini	36	311	0
10	August Muench	A.Muench	36	311	0
11	Benjamin Grinstein	B.Grinstein	24	283	26.682
12	Bożena Czerny	B.Czerny	36	311	0
13	Brad Gibson	B.Gibson	36	311	0
14	Brian Jackson	B.Jackson	36	311	0
15	Butler Burton	B.Burton	36	311	0
16	Carraro Giovanni	C.Giovanni	36	311	0
17	Chris Lintott	C.Lintott	36	311	0
18	Christopher McKay	C.Mckay	7	411	170
19	Christian G. Boehmer	C.G.Boehmer	23	284	0
20	Christopher Conselice	C.Conselice	36	311	0
21	Daniel J. Scheeres	D.J.Scheeres	39	258	1961

No	Name/Family name	Abbreviate name	Degree	Closeness	Betweenness
22	Daniel W. Savin	D.W.Savin	36	311	0
23	Daniela Billi	D.Billi	5	496	0
24	Dharam V. Ahluwalia	D.V.Ahluwalia	18	328	19.567
25	Dieter H. Hartmann	D.H.Hartmann	36	311	0
26	Dmitri V. Gal'Tsov	D.V.Galtsov	26	281	19.171
27	Dmitry S. Gorbunov	D.S.Gorbunov	28	279	45.213
28	Dmitry M. Gitman	D.M.Gitman	26	281	19.171
29	Donghui Jeong	D.Jeong	23	284	0
30	Drahomir Chochol	D.Chochol	1	375	0
31	Edgard G. Rivera-Valentín	E.G.Rivera-Valentin	36	311	0
32	Eiichiro Komatsu	E.Komatsu	18	334	5.784
33	Elias C. Vagenas	E.C.Vagenas	34	265	227.416
34	Eric D. Feigelson	E.D.Feigelson	36	311	0
35	Erik Verlinde	E.Verlinde	28	272	149.619
36	Ethan Vishniac	E.Vishniac	36	311	0
37	Fabian Walter	F.Walter	36	311	0
38	Faith Vilas	F.Vilas	36	311	0
39	Filippo Vernizzi	F.Vernizzi	14	339	0.835
40	Frances Westall	F.Westall	5	496	0
41	Francois Raulin	F.Raulin	3	415	0
42	Françoise Combes	F.Combes	0	846	0
43	Frank Timmes	F.Timmes	36	311	0
44	Frederic Rasio	F.Rasio	36	311	0
45	Gary Zank	G.Zank	36	311	0
46	Gennady S. Bisnovatyi Kogan	G.S.Bisnovatyi-Kogan	28	279	185.445
47	Gerald V. Dunne	G.V.Dunne	24	283	26.682
48	Greg J. Schwarz	G.J.Schwarz	36	311	0
49	Greg Landsberg	G.Landsberg	28	272	149.619
50	Gregory J. Herczeg	G.J.Herczeg	36	311	0
51	Huixin Liu	H.Liu	2	288	0
52	Hyung M. Lee	H.M.Lee	1	428	0
53	Igor D. Karachentsev	I.D.Karachentsev	2	367	0
54	Jan Vondrak	J.Vondrak	3	286	٨٩
55	Jeremy Mould	J.Mould	23	284	0
56	Joan M. Wrobel	J.M.Wrobel	36	311	0
57	John I. Brauman	J.I.Brauman	1	399	0
58	Joseph Burns	J.Burns	3	295	0
59	Juan Garcia-Bellido	J.Garcia-Bellido	31	275	64.222
60	Judith Pipher	J.Pipher	36	311	0
61	Kirill A. Bronnikov	K.A.Bronnikov	26	281	19.171
62	Kleomenis Tsiganis	K.Tsiganis	7	245	2003.5
63	Lee Armus	L.Armus	36	311	0
64	Leon Golub	L.Golub	36	311	0
65	Luigi Stella	L.Stella	36	311	0
66	Luis C. Ho	L.C.Ho	37	310	89
67	Manolis K. Georgoulis	M.K.Georgoulis	36	311	0
68	Maria Womack	M.Womack	36	311	0
69	Mark Trodden	M.Trodden	29	278	78.85
70	Maxim Y. Khlopov	M.Y.Khlopov	32	274	76.664
71	Michael Endl	M.Endl	36	311	0

No	Name/Family name	Abbreviate name	Degree	Closeness	Betweenness
72	Michael Thoennessen	M.Thoennessen	3	365	0
73	Mikhail A. Vashkov'yak	M.A.Vashkovyak	0	846	0
74	Mikhail V. Sazhin	M.V.Sazhin	9	343	8.227
75	Misao Sasaki	M.Sasaki	18	334	5.784
76	Olaf Reimer	O.Reimer	0	846	0
77	Parampreet Singh	P.Singh	31	275	64.222
78	Pascale Ehrenfreund	P.Ehrenfreund	7	411	170
79	Peter Dunsby	P.Dunsby	31	275	64.222
80	Ralf Moeller	R.Moeller	5	496	0
81	Ralph Wijers	R.Wijers	0	846	0
82	Rekha Jain	R.Jain	36	311	0
83	Rita Bernabei	R.Bernabei	28	272	149.619
84	Rong G. Cai	R.G.Cai	18	328	19.567
85	Ruth Durrer	R.Durrer	7	346	0
86	Sergei D. Odintsov	S.D.Odintsov	18	333	6.894
87	Shadia Habbal	S.Habbal	36	311	0
88	Shuanggen Jin	S.Jin	11	332	581
89	Stefano Liberati	S.Liberati	28	279	45.213
90	Stefano Profumo	S.Profumo	24	283	8.643
91	Steinn Sigurdsson	S.Sigurdsson	36	311	0
92	Steven Kawaler	S.Kawaler	36	311	0
93	Steven M. Crawford	S.M.Crawford	36	311	0
94	Xuelei Chen	X.Chen	14	339	89
95	Zita Martins	Z.Martins	55	496	0

The data in Table 5 show the EBMs of astronomy and astrophysics journals with EBI based on centrality indicators (degree, closeness, and betweenness). "Daniel J. Scheeres" and "Luis C. Ho" have the highest centrality at 39 and 37, respectively. The data analysis in Table 5 also shows that four EBMs jointly gained the highest closeness centrality. These people, who have gained a closeness centrality of approximately 846, are "Françoise Combes," "Mikhail A. Vashkov'yak," "Olaf Reimer," and "Ralph Wijers," "Kleomenis Tsiganis (2003.5)," "Daniel J. Scheeres (1961)" and "Alexander F. Zakharov (1013.5)" who had the highest betweenness centrality, respectively (Table 5).

SNA of EBMs with EBI (Centrality Measurements)

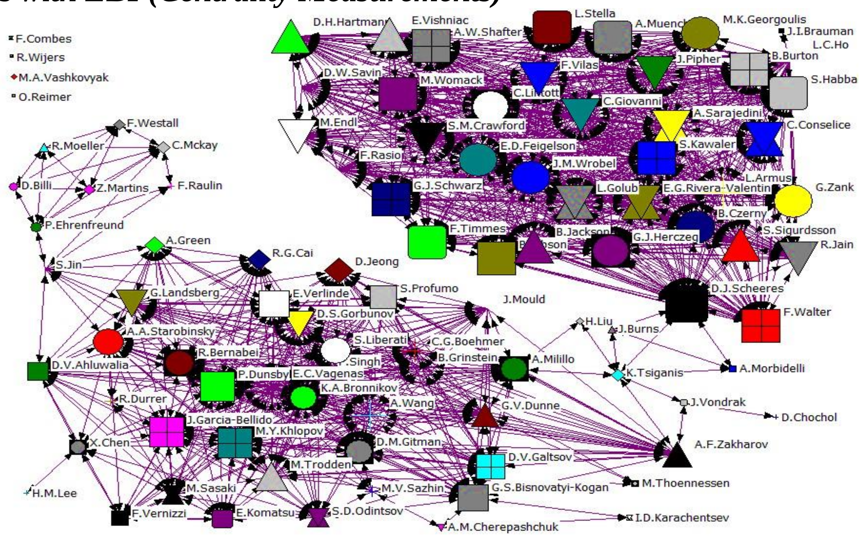

Figure 2: Network of EBMs with EBI based on degree centrality

Figure 2 shows that "D.J. Scheeres" (39) and "Luis C. Ho" Luis C. Ho’ (37), with the highest degree of centralities, had the largest nodes. The smaller the network members' connections, the smaller the nodes, so that the individuals with a degree centrality of zero are only in the left corner of the figure with the smallest node size. These four scholars are “F. Combes, M.A. Vashkovyak, O. Reimer, and R. Wijers,” appearing in only two journals (Figure 2).

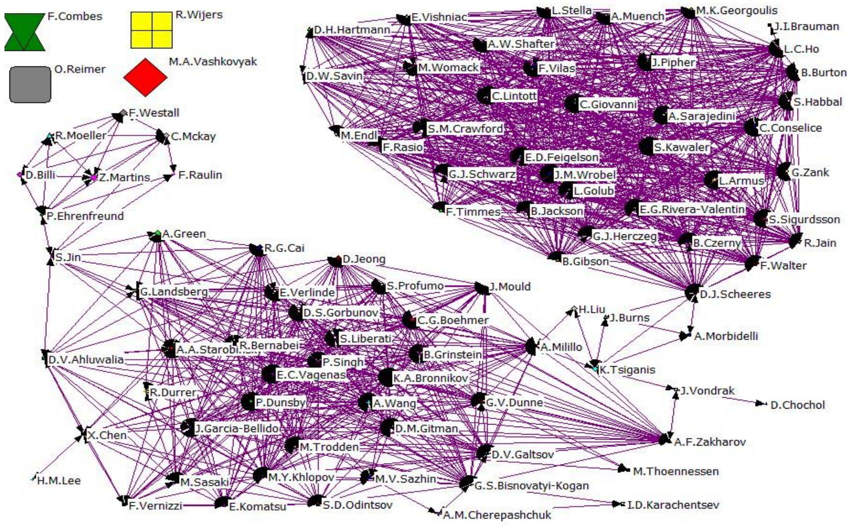

Figure 3: Network of EBMs with EBI based on closeness centrality

According to Figure (3), some individuals (F. Combes, M.A. Vashkovyak, O. Reimer, and R. Wijers) with high closeness centralities are more likely to receive information faster than others because there are fewer mediators between them. Therefore, they receive information without intermediaries. “A.F. Zakharov, A. Millillo, and K. Tsiganis,” with the least closeness centralities (241, 242, and 245, respectively), have the highest number of mediators to reach others and therefore have the lowest closeness centralities (Figure. 3).

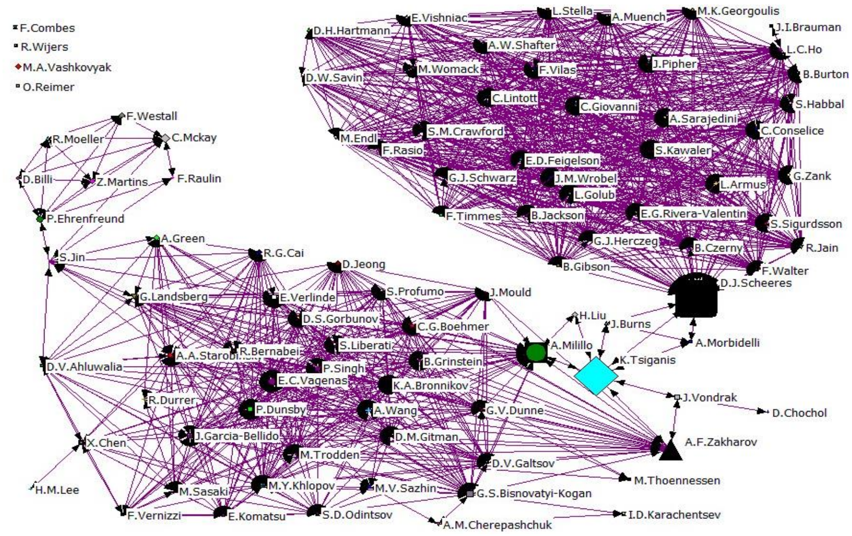

Figure 4: Network of EBMs with EBI based on betweenness centrality

Figure 4, “K. Tsiganis and S. Jin,” connect the three clusters with betweenness centralities of 2003.5 and 581. The role of “K. Tsiganis” in connecting three clusters is more productive and effective. Betweenness centralities of the list of the first four people, “K. Tsiganis, D.J. Scheeres, A.F. Zakharov, A. Millillo, and S. Jin,” are equal to 2003.5, 1961, 1013.5, and 968, respectively.

Discussion

The paper aimed to assess the EBI phenomenon in astronomy and astrophysics journals using SNA and a descriptive-analytical approach. In this regard, 1394 scholars of astronomy and astrophysics occupied 1597 job positions in the form of the chief editor, associate editor, and editorial board member in 67 journals. It was found that astronomy and astrophysics journals also had an EBI. Therefore, the results of the present study are consistent with the research results of Lockstone-Binney, Ong and Mair (2021) on tourism, Goyanes & De-Marcos (2020) on communication sciences, Teixeira and Oliveira (2018) on KM-IC, Andrikopoulos and Economou (2015) on financial economics, Baccini and Barabesi (2009) in economics journals, and Baccini and Barabesi (2011) on LIS. The results of the analysis of the social network of EBMs in journals are also in line with the results of Liwei and Chunlin (2015) on LIS, Baccini, Barabesi, and Marcheselli (2009) on statistics, and Burgess and Shaw (2010) on management and business.

The results on the academic rank and gender of EBMs indicate that the most significant number of EBMs with EBI are professors, associate professors, and assistant professors, respectively, and gender inequality was observed in EBMs of the studied journals. In other words, men are more likely to collaborate in astronomy and astrophysics journals as EBMs more than 4.5 times than women.

This is in line with the results of studies by Lockstone-Binney, Ong and Mair (2021), who studied tourism journals; Goyanes & De-Marcos (2020) in the communication sciences' journals that refer to the gender variable and Metz and Harzing (2009 and 2012) in management journals and Burgess and Shaw (2010) who studied the structure of Management and Business journals. Given that the composition of the EBMs of the research populations is predominantly male, it can be inferred that gender discrimination and gender inequality in the realm of astronomy and astrophysics have also overshadowed the journals active in this field. In general, it can be said that most of the EBMs of astronomy and astrophysics journals have male and male textures. Goyanes & De-Marcos (2020) also found that the number of male editorial board members in communication science journals was twice that of women.

Given the entry and activity of women in the academic and occupational levels of astronomy and astrophysics, scientific supremacy in subject areas (such as astronomy and astrophysics) should not continue under the influence of male professors alone. Women's human capital should also be reviewed and considered. In this way, the scientific authority of female faculty members in astronomy and astrophysics can facilitate their further membership in this field's editorial board of journals. The results showed that in terms of scientific rank, the researchers in the six groups were present in the scientific ranks of professor, senior researcher, associate professor, retired professor, assistant professor and instructor in the journals of the research population. The findings indicated that the United States has the highest number of professors, senior researchers, associate professors, retired professors and assistant professors in astronomy and astrophysics journals. Regarding the academic rank of the editorial board members, no previous research results were observed EBMs academic ranks.

The results showed that more than one-third of the EBMs have EBI are Americans. Russia is in second place, and Britain and Italy are in third place. More than a third of the journals that have EBI are also from the United States. After the American journals, the Dutch, Russian and British journals are ranked second to fourth, respectively, regarding the share of countries publishing journals with an entanglement of astronomy and astrophysics. In addition, half of the publishers of entangled astronomy and astrophysics journals share American, Russian, and English nationalities. In line with the results of the present article, (Goyanes & De-Marcos, 2020) also addressed the impact of geographical diversity on the EBMs of 84 journals of communication science indexed in the JCR. Their results showed that the United States and the countries of Western Europe are the core of global knowledge production.

(Burgess & Shaw, 2010) also analyzed the social network of EBMs of management and business journals. They read 36 Financial Times lists, including 2,405 EBMs, 512 organizations, and 45 countries. Their research showed that the top positions of membership in the EBMs of journals are from those American universities and high-level organizations. They believe that the EBMs of management and business journals were primarily male and from North American countries. Their research indicated inequality and gender and geographical discrimination among members of the EBMs of management and business journals.

Among 67 journals, 1597 job positions, 634 organizations, 46 journals, 95 researchers, and 79 organizations had EBI. Astrophysical Journal Letters, “Astrophysical Journal Letters,” “Astronomical Journal,” “Astrophysical Journal,” and “Astrophysical Journal Supplement Series” had the highest EBI among astronomy and astrophysics journals. The results regarding EBMs with the highest EBI showed that three out of 95 EBMs had an EBI equal to 5. "Aleksei A. Starobinsky" from Russia and affiliated with the Russian Academy of Sciences, "Daniel J. Scheeres" from the United States and works at the University of Colorado Boulder; and "Luis C. Ho" from China and affiliated with Peking University had the highest EBI; they were professors and collaborated with five astronomy and astrophysics journals.

The highest amount of EBI at the organizational level was awarded jointly to the “Russian Academy of Sciences,” “the University of Colorado Boulder,” and “Peking University.” These organizations are influential and decisive in astronomy and astrophysics. The present study results are consistent with Goyanes & De-Marcos (2020).

"Daniel J. Scheeres" achieved the highest centrality among EBMs with EBI. SNA and analysis of the types and number of links and connections that a network member has established with other network members provide valuable information about elite, prominent, and influential people in that network. They also include essential information for planning, management, predicting, and achieving objectives. Centrality metrics are used to identify significant or crucial factors in scientific networks. A person's greater centrality leads to a higher rank, more communication and collaboration, and a more desirable position, making that person more influential in the social network. Therefore, researchers' effectiveness is affected by their publications. Researchers with high-ranking centrality have a unique role in attracting new people to the scientific network. Consequently, it is considered the most influential researcher in that scientific collaboration network and a kind of asset in that subject area (Danesh, 2020).

Degree centrality is a network measure helpful in analyzing the structures of the entire network and the positions of individuals in the network. Degree centrality refers to the number of entered/exited links from a node in a network (Freeman, 1979). This measure is related to the position of the individuals in a network. A person in the information network with a high degree of centrality is considered capable of creating organizational skills, experiences, and memory for others; they can be called the organization's asset. This person can also act as a mentor for newcomers (Parise, 2007). Centrality Degree calculates the number of connections with other people in a network. The strong bonds of these people are easily visible with large and small blue dots.

It is necessary to identify individuals who can act as a bottleneck for information flow and potentially be overloaded with information requests (Cross & Prusak, 2002). “D.J. Scheeres and Luis C. Ho" also have the highest EBI. The closeness centrality measures a scholar's distance from all other scholars in the network. The closer a scholar is to others, the more selective and famous ones are. Some scholars, including "F. Combes, M.A. Vashkovyak, O. Reimer, and R. Wijers," with high closeness centrality, jointly have the most elevated position in the closeness centrality; therefore, the knowledge flow among network members. In addition, they have more power and influence than other researchers, and they probably receive information much faster than others because there is less mediation between them. Many social researchers argue that closeness centrality is not attractive for large networks because one factor is usually close to only a small set of factors in an extensive social network.

Furthermore, the closeness indicator can mean that the author who is closer to other network members, has faster access to all researchers in the collaboration network than anyone else. Moreover, that author gains more citations for his/her publications by accessing the necessary resources more appropriately. Placing at the closeness centrality and having the shortest distance with researchers in a network can be of strategic importance to that researcher; however, it does not necessarily improve his/her performance. A higher opportunity and chance to communicate with other researchers, if not accompanied by a direct co-authorship relationship, will lead to increased knowledge exchange and negatively affect the researcher's performance.

Conclusion

Since there is a need for connections providing the conditions for the exercise of power and influence in a collaboration network, the presence of a researcher who communicates between groups of people is remarkable. The measure of betweenness centrality is usually too small for most factors in large social networks (Penn, 2007). "A.F. Zakharov, A. Millillo, and K. Tsiganis," with the lowest closeness centrality, have the highest number of mediators to reach others. Betweenness centrality identifies the position of an entity within a network in terms of its ability to communicate with other pairs. Betweenness centrality is a point between many other pairs of points; it is an intermediate point through which the connection channels of other places pass. "K. Tsiganis and S. Jin" are scholars who have connected three clusters. The role of "K. Tsiganis" is effective and productive in linking three clusters. The betweenness centrality is considered one of the most significant measures for analyzing and controlling the network's knowledge and flow of resources or information. Therefore, it plays an intermediary role (betweenness) in the exchange and information flow, performance improvement, and attraction of the right ideas.

Moreover, due to "K. Tsiganis" central position in the network, he has many relationships with other researchers and has an important strategic role in the overall structure of the network. The results of degree, closeness, and betweenness centrality measurements for each of the journals in the present study are consistent with the results of studies conducted by Baccini, Barabesi, and Marcheselli (2009), who analyzed the connections between journals of statistics using the network analysis method. Moreover, Baccini and Barabesi (2009) investigated the centrality among 124 journals of economics.

Analysis of the research results by (Baccini et al., 2009), who had studied statistics and probability journals, showed that the average centrality rank of these journals is 44.9, while the median rank is 8, the standard deviation is 7.54. Also, the review of the results showed that the closeness centrality of 75 journals is 0.35, which indicates that the network of statistics and probability journals is centralized. The results of betweenness centrality in all journals of statistics and probability were 0.1 (Baccini et al., 2009). The results of the Research Center Indicators section by (Baccini & Barabesi, 2009), who reviewed 124 journals of economics, are comparable to the results of the present research centrality metrics. In (Baccini & Barabesi, 2009), the centrality metrics for journals are calculated. The more journals are related to other journals, their position on the network is more pivotal. In the research of (Baccini, & Barabesi, 2009), "The Pacific Economic Review (PER)" is the most central journal of economics and is related to 124 other journals and plays a central role. This is while the Journal of Development and Economic Policies is on the sidelines (Baccini & Barabesi, 2009).

A review of the JCR suggests that there is a variety of other subject areas in physics, such as "PHYSICS, NUCLEAR," "PHYSICS, ATOMIC, MOLECULAR & CHEMICAL," and "PHYSICS, PARTICLES & FIELDS." The suggestion is that EBI is evaluated in one or more physics journals and compared with the present study results.

Some journals show no data regarding the status of EBMs. The suggestion is that the EBI phenomenon is analyzed in the journals of other subject areas related to physics in the JCR, and the results are analyzed, compared, and reported.

The results of the present study indicated that 95 patients had EBI. The suggestion is that publications, scientific collaborations, and citations of these people be evaluated in research and determined how many of their publications and citations are from journals in which they are EBMs. Moreover, how much of their scientific contribution is to other EBMs with EBI in similar journals should be analyzed.

The present study results revealed the presence of men > 4.5 times compared to women in the EBMs of astronomy and astrophysics journals. Thus, the statistical population faces the phenomenon of gender inequality; hence, another suggestion is that this issue is assessed and practical solutions are provided in an independent and interdisciplinary survey collaborating with sociology and psychology experts.

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Conflicts of interest/Competing interests: Does not exist

Availability of data and material: It is entirely transparent and accessible

Code availability**:** Software application or custom code not used

Ethics approval**:** Research is Scientometrics and is not a task requiring ethical approval.

Consent to participate**:** Not Applicable

Consent for publication**:** Not Applicable

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