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Analyzing the funding and personal acknowledgements of the publications of the University of Kerala during 2001-2018

Deepika Lakshman[a] and Mini Devi[b]

[a]Research scholar (Part Time), Department of Library & Information Science, University of Kerala and Assistant Librarian cum Documentation Officer, Kerala State Higher Education Council, Thiruvananthapuram,
Email:deepikalak07@gmail.com

[b]Assistant Professor and Head, Department of Library and Information Science, University of Kerala, Thiruvananthapuram
Email: drminidevi1968@gmail.com

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Acknowledgements have caught the attention of policy makers as they, like citations, indicate influential contributions to a scientific work. The present paper analyzes the acknowledgements-funding and personal- of the research output of the University of Kerala for the period 2001-2018. Of the 1972 records extracted from the Web of Science, 829 records (42%) had funding information. Among the countries, other than India, the United States was the leading country with 26 funding agencies. There were 166 unique funding agencies of which the Government agencies were the predominant funders. Though Chemistry had the largest number of funded publications, the research area of Geology was seen to be funded by the largest number of 25 funding agencies. Personal acknowledgements were categorized into five main categories and the category- "Access to Research Related Information" accounted for 46.02% and "Peer Interactive Communication" accounted for 16.82% of the acknowledgements. The lack of consistency of acknowledgment data still poses difficulty in analyzing the acknowledgment section.

Keywords: Bibliometrics; Funding acknowledgements; Personal acknowledgements; University of Kerala, Scientometrics

Introduction

In the modern era, scientific research has become multidisciplinary and interdisciplinary with contributions from multiple researchers. Currently, an impactful scientific research outcome requires a collaborative teamwork and this situation has led to a worldwide network of collaboration in science. Co-authorships, the proxy of collaboration helps to understand the collaboration at institutional and individual levels, and the network structure of collaborations, but does not provide a complete picture of the many others who have contributed to the research in some way or the other and are yet not considered authors. The recognition of the "non-authors" is done through the acknowledgment section of the publications. Patel[1] terms this as "sub authorship collaboration".

According to Cronin, McKenzie and Stiffler[2] acknowledgements can be of many kinds, ranging from dutiful genuflection to a funding body, to expression of thanks for study space, facilities made available, analyses and interpretation of data, access to specimens, to a sincere and elaborate expression of gratitude for seminal ideas or input provided by a trusted assessor.

The recent inclusion of acknowledgment text in the databases like Web of Science (WoS), Scopus and PubMed and the intense interest from academia and policy makers has led to the growth of its bibliometric analysis. The acknowledgement text provides details of the funding agency, its affiliating country and expressions of gratitude to a co-worker which could range from a brief one line expression of gratitude to a paragraph-length statement acknowledging a wide variety of support from institutions, agencies, co-workers and mentors. The main drawback of the acknowledgement text is its lack of standardization and heterogeneous content.

This study makes an attempt to study the characteristics of the funding agencies involved and analyze the different categories of acknowledgements, as collected from the acknowledgement text. The study is based on the records extracted from the Web of Science (WoS) of the research output of the University of Kerala for the period 2001-2018.

Literature review

Several studies have been published which deal with the analysis of the funding information in research publications. Wang and Shapira[3] have

explored the funding patterns of countries involved in nanotechnology research for the period 2008-2009 from published articles. Using funding acknowledgment data, the agencies involved at national and organizational levels of selected countries were identified and it was found that nanotechnology was funded mostly by national agencies.

Huang and Huang[4] analyzed journal articles of G9 countries for the period 2009-2014 from WoS and identified China to have the most funded papers and Italy with the least funded papers. Government agencies were found to be the major sponsors. Funding was more in the subject area of Life Sciences.

Balasubramani, Siriwardena and Abu[5], on examining the funding in BRIC (Brazil, Russia, India and China) countries based on the Science Citation Index of WoS, found the papers published from China to be the most funded. Single agencies funded much of the papers in Russia and China, while diverse funding agencies supported the research publications of India and Brazil.

Lewison and Roe[6] in their study on cancer research in India have identified the Government of India to be the main funder and that alternative funders were limited. The study on funding was done for a two year period of 2009-2010. Zhao, Tan, and Yu[7] have addressed the relationship between funding and Usage Count, a metrics on the WoS platform and found that the impact of funding on usage and citation varied across disciplines. Mejia & Kajikawa[8] on analyzing robotics research have characterized funding agencies into four categories depending on the technologies-breakthrough, change maker, incremental, and matured as mentioned in the acknowledgment section of articles. Majority of the financial acknowledgments were of the incremental type followed by the matured, breakthrough, and change maker categories.

Cronin and Weaver[9] have explained the importance of counting acknowledgements along with authorship and citations. Cronin, McKenzie and Weaver-Wozniak[10] consider acknowledgements to imply intellectual debt and as a metric parallel to citations in the academic audit process.

Diaz-Faes and Bordons[11] analyzed the acknowledgements in English language papers published by Spanish researchers in different subject areas and found two thirds of the articles to mention funding acknowledgements. The category of acknowledgement-"*Peer interactive communication*" was found to be predominant in theoretical fields while the category of "*Technical assistance*" dominated in the field of experimental research. Cronin, Shaw, and Barre[12] have opined that acknowledgment has gradually established itself as a constitutive element of academic writing. McCain[13] on a survey conducted on experimental geneticists mentioned that a variety of research related information is provided, used and acknowledged during the course of research. Costas and van Leeuwen[14] have analyzed the publications in Web of Science in 2009 and observed that publications with funding agencies present a higher impact. China was the country which had largely acknowledged the funding agencies and the category of "*Peer Interactive Communication*" acknowledgment compensated for the low level of collaborations in humanities and social sciences.

Several studies have examined the acknowledgment patterns of individual journals. Tiew and Sen[15] on analyzing the acknowledgment patterns of research articles in the *Journal of Natural Rubber Research* for the period 1986-1997 have found "*Peer Interactive Communication*" to account for 44% of the total acknowledgements. Rattan[16] analyzed the acknowledgements appearing in the research articles and short communications in *Annals of Library and Information Studies* during the period 1999-2012. More than 20% of communications contained acknowledgements and of the different categories "*Peer Interactive Communicatio*n" was the most common type. The most acknowledged individuals were also identified. Yet another study conducted by Rattan[17] on the generic structure of acknowledgements appearing in the *DESIDOC Journal of Library & Information Technology* (*DJLIT*) covering the period 1998-2013 found 9.04 % articles to contain acknowledgements. The acknowledgements were classified into eight categories and of which "*Peer interactive communication*" acknowledgements accounted for 29.16 %, while the "Editorial/ linguistics support" (E/LS) acknowledgements was the lowest (1.04 %). The list of individuals acknowledged in Peer Interactive Communication (PIC) category along with their institutional affiliations were also discussed. Desrochers, Paul-Hus and Pecoskie[18] on reviewing the literature of 50 years of research on acknowledgements found a lack of consensus on the value and functions of acknowledgements with the reward system of science.

Objectives of the study

- To examine the year-wise trend of the funded and non-funded publications for the period 2001-2018;
- To identify the countries involved in funding;
- To identify the main funding agencies of the University of Kerala at the national and international level;
- To identify the research areas that are funded, and the agencies involved; and
- To identify the different categories of personal acknowledgements

Methodology

The research output of the University of Kerala for the period 2001-2018 was extracted from the Web of Science Core Collection database using the search option Organization enhanced "University of Kerala" for the period 2001 to 2018(inclusive).The retrieved set consisted of 1972 records. The field tags FU-Funding Agency and Grant Number, FX-Funding Text of the database were used for analyses. FU provides funding details which includes, names of the funding agencies, grants, grant numbers, awards, fellowships and the field FX-provides information such as support, encouragement, discussions, providing data, use of facilities-such as equipment, transportation, providing specimens etc. Bibexcel, the software was used to analyze the funding data which was then exported to MS Excel/Google Spreadsheet to carry out further analysis. The details of the funding agencies and countries were verified and standardized. Some papers were funded by multiple agencies. As, it is not possible to ascertain the proportion of funding by each agency, it was decided to use the whole counting method where each funding agency of a publication was given equal weightage of one.

A classification of personal acknowledgements developed by McCain, 1991[13] was adopted for the study. The text of the acknowledgements was categorized into 13 specific headings which were classified into five broad headings viz- i) Access to research related information; ii)Access to unpublished results data; iii) Peer Interactive Communication; iv) Technical Assistance and v) Manuscript Preparation.

Results and Discussions

Year-Wise Funded Papers

Figure 1 shows the number of papers that have information on funding from 2001 to 2018. Of the 1972 publications, 829(42%) papers were found to be funded by any one agency. The maximum number of funded papers was in the year 2017 at 130. Though, there was an increase in the number of funded papers since 2005, the year 2015 showed a slight decrease in the percent of funded papers.

On comparing the funded and non-funded publications in each year, the year 2018 accounted for

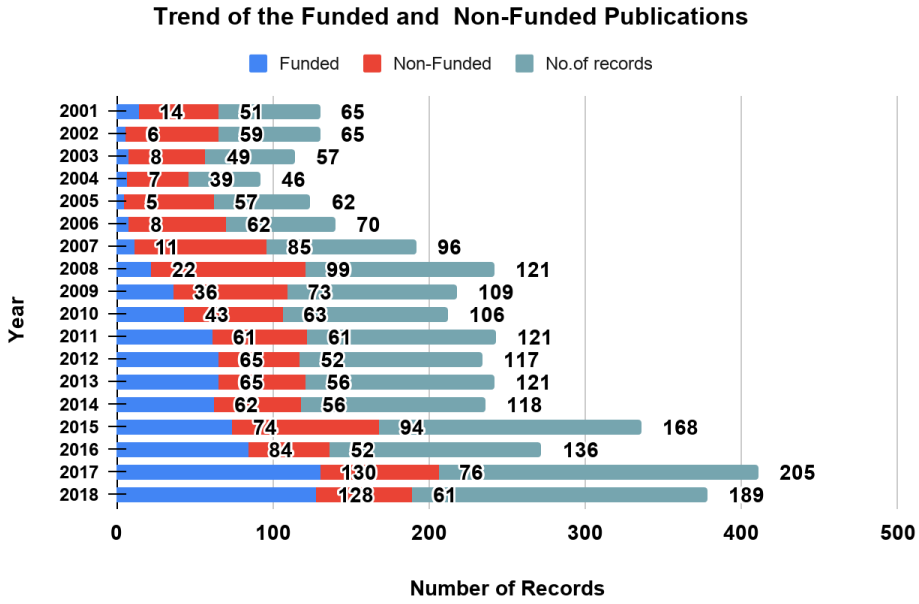

Fig. 1 — Trend of the funded and non-funded papers over the years

67.72% of funded papers against the non-funded papers, while the years 2017 and 2016 accounted for 63.31% and 61.76% of funded papers respectively. The year 2005 was marked with the least percent of funded papers at 8.06 and the year 2011 had an equal number of funded and non-funded papers.

Funding Countries/Agencies

Funding agencies were classified according to the country of origin based on their affiliations. When the countries of the agencies were not mentioned in the acknowledgment text, the following methods were employed to identify the country i) the names of the countries were derived from the adjectival form (eg: Chinese) ii) from names of regions or cities which could be clearly attributed to a country (eg: Beijing could be attributed to China) iii) Names of well-known organizations as in the case of National Institute of Health which is situated in the United States. In cases where the countries could not be assigned by the above methods, web searches were conducted to ascertain them.

It was found that the funding agencies were dispersed across 29 countries including India. As expected, India topped with 50 unique funding agencies, followed by the United States (26); United Kingdom(17); China(9), Sweden(6); Canada(5), The Netherlands, Spain, Japan, Germany(4 each) and Slovenia(3).

For the purpose of this study, the funding agencies have been broadly divided into External Funding agencies, National Funding agencies and State Funding agencies. The External funding agencies included the funding agencies outside India and other international and transnational organizations. National agencies included those agencies of India and the State agencies included those of the State of Kerala. These were further sub categorized into Government, Private and Non-Governmental agencies etc.

Out of the 166 unique funding agencies that funded University of Kerala, there were 116 External funding agencies, 40 National Funding agencies and 10 State agencies. Figure 2 shows the categorization of the funding agencies. Government agencies which included Ministries and Departments and the Public Universities, Research Institutes and Public Sector Units were the major funders among the external and national agencies.

External funding agencies

External agencies constituted 69.87 per cent of the total funding agencies. Among the external agencies, the Ministry of Science of Slovenia with 16 funded papers; Japan Society for the Promotion of Science (11) and National Institute of Health (10) were the top three funding agencies. Some other prominent external agencies who have also provided assistance to a lesser extent include China University of Geosciences; National Science Foundation-USA; Royal Society-UK; Michigan Technological University-USA; Stanford University and the British Council.

International organizations like the International Atomic Energy Agency-Austria; United Nations Development Programme-United States and the World Conservation Union-United States; and Trans-National Organizations viz-United States India Education Foundation (USIEF); UK India Education

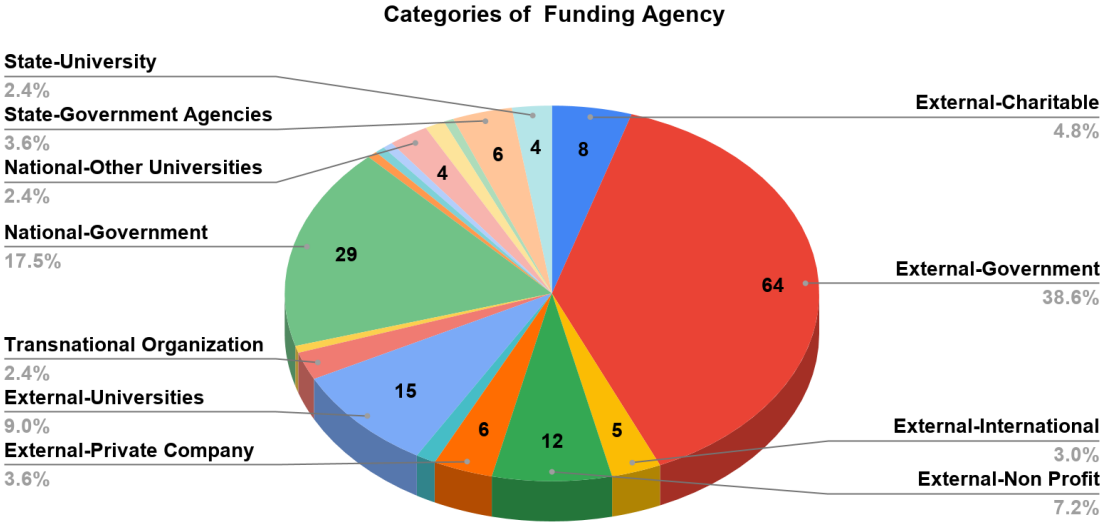

Fig. 2 — Categorization of the funding agencies

and Research Initiative(UKIERI); Amphibian Specialist Group of Conservation International, IUCN-United Kingdom; Indo-French Centre for the Promotion of Advanced Research(IFCPAR/ CEFIPRA); CEPF funded Western Ghats Network of Protected Areas for Threatened Amphibians-United Kingdom etc. were some of the agencies which have aided the research.

National funding agencies

Analysis showed that National agencies constituted 24.10 % of the total funding agencies and included the major central funding agencies, ministries and departments, research institutes, public sector units, universities, charitable organizations and Non-Governmental Organizations (NGOs). It can be seen from Figure 2 that the category of Government agencies alone made up for 17.47% of the funding agencies and were the major funders.

The top three funders at the national level were University Grants Commission (UGC) having funded 37.15% of the funded papers, Department of Science and Technology (15.20%) and the Council of Scientific and Industrial Research (14.60%). The other prominent national agencies were the Department of Biotechnology, Indian Council of Medical Research and the Science and Engineering Research Board.

Some of the schemes and programmes through which these agencies have funded the research include Basic Research Fellowship; CAS Programme; Dr DS Kothari Post-Doctoral Fellowships in Sciences, Medical Sciences & Engineering Sciences; Faculty Development Programme; Junior and Senior Research Fellowships; Moulana Azad National Fellowship; Rajiv Gandhi National Fellowship. Raman Fellowship for Post-Doctoral Research in USA; DAAD PPP Programme; Fast Track Research Project; FIST Programme; INSPIRE Fellowship; Nano Science and Technology Initiative; Promotion of University Research and Scientific Excellence(PURSE); Solar Research Initiative(SERI); Women Scientist Scheme and the Young Scientists Scheme.

State agencies

Among the State agencies, Kerala State Council for Science, Technology and Environment (KSCSTE) funded 22.07% of the funded publications and was also the second top funding agency among all the agencies. The other prominent agencies of the State of Kerala were-Kerala Agricultural University, University of Kerala, Kerala State Biodiversity Board, Kerala State Higher Education Council and Kerala State Welfare Board.

The list of the top 14 agencies which funded up to 10 publications is given in Table 1

Multilateral funding agencies

It was observed that publications were supported not only by single agencies but also by multiple agencies across different countries. It was seen that 590 papers were funded by single agencies. Multiple agencies either from a single country or from multiple countries have provided financial assistance to a paper simultaneously. Table 2 shows that as many as five countries have been involved in funding the publications simultaneously. There is only one instance where 10 funding agencies were found to fund a paper and these funding agencies were affiliated to two countries viz-United States and the United Kingdom and this is attributed to the paper titled "SBOL Visual: A Graphical Language for Genetic Designs" published in the journal *PLOS Biology* in 2015 with author-Umesh, P. being affiliated to the Department of Computational Biology & Bioinformatics, University of Kerala.

It was also observed that 158 publications were funded exclusively by bilateral agencies and

Table 1 — Top funding agencies

	Funding agency	No. of funded papers
1.	University Grants Commission(UGC)	308
2.	Kerala State Council for Science, Technology and Environment (KSCSTE)	183
3.	Department of Science and Technology(DST)	126
4.	Council of Scientific and Industrial Research(CSIR)	121
5.	University of Kerala	60
6.	Department of Biotechnology(DBT)	34
7.	Government of Kerala	22
8.	Ministry of Science and Technology-India	17
9.	Indian Council of Medical Research(ICMR)	17
10.	Science and Engineering Research Board (SERB)	16
11.	Ministry of Science of Slovenia	16
12.	Japan Society for the Promotion of Science(JSPS)	11
13.	National Institute of Health(NIH)	10
14.	National Board for Higher Mathematics(NBHM DAE)	10

81 publications were funded by multiple agencies.

Subject areas funding

The WoS tag SC-Research Areas[19] was analyzed to identify the predominant research areas of the University of Kerala. Table 3 shows the number of funding agencies involved in funding the research areas

Table 2 — Multilateral countries and multiple funding agencies

Number of Countries simultaneously involved in Funding	Number of Funding Agencies involved simultaneously						
	1	2	3	4	5	Upto 10	Grand Total
1	590	123	30	7	4	1	755
2		35	19	5	1	4	64
3			3	3	2		8
4					1		1
5					1		1
Grand Total	590	158	52	15	9	5	829

Table 3 — Research areas and the number of funding agencies involved

Subject Areas	Funded Papers	Number of Unique Funding Agencies		
		External	National	Total no. of agencies
Chemistry	63	4	12	16
Mathematics	45	5	8	13
Pharmacology & Pharmacy	35	7	14	21
Materials Science	31	2	7	9
Geology	31	17	7	25
Zoology	23	5	9	14
Endocrinology & Metabolism	17	2	7	9
Engineering	16	-	7	7
Environmental Sciences and Ecology	16	3	4	7
Science and Technology-Other Topics	12	-	5	5
Spectroscopy	11	-	6	6
Physics	11	-	7	7
Cell Biology	11	5	4	9
Materials Science; Physics	10		5	5
Biochemistry & Molecular Biology; Cell Biology	10	1	6	7

The major research areas with at least 10 funded papers were identified as the following viz-Chemistry with 63 papers Mathematics (45), Pharmacology & Pharmacy(35), Materials Science(31), Geology(31), Zoology(23), Endocrinology & Metabolism(17), Environmental Sciences and Ecology(16), Engineering (16)Science and Technology-Other Topics(12), Spectroscopy(11), Physics(11), Cell Biology(11), Materials Science; Physics(10), Biochemistry & Molecular Biology; Cell Biology(10).

However, while analyzing the funding agencies involved in these research areas, it was found that the research area-Geology was funded by 25 agencies, Pharmacology & Pharmacy (21), Chemistry (16), Zoology (14), Mathematics(13) and the rest are tabulated in table 3.

In all the above subject areas, except for Pharmacology & Pharmacy, Geology and Cell Biology, the major funding agency was University Grants Commission. These three subject areas were mainly funded by Kerala State Council for Science, Technology and Environment.

Funding and citations

The number of citations received for funded and non-funded papers were also looked into. The funded publications received 9746 citations while the 1143 non funded papers obtained 15492 citations. The funded paper which received the maximum citations of 613 was published in the year 2008 and funded singly by Clayton Foundation for Research, United States in the area of Pharmacology & Pharmacy. The foundation is a non-profit organization conducting research to identify the cause and prevention of diseases. The paper was co-authored by 11 authors with two authors affiliated to the Department of Chemistry-University of Kerala. The non-funded paper which obtained maximum citations of 329 in the area of Biochemistry was also published in 2008 and was co-authored by five authors, with two authors affiliated to the Center for Arthropod Bio resources and Biotechnology of the University of Kerala.

Analysis of the acknowledgment text

The funding text of the publications of University of Kerala were categorized as seen in table 4. There were 535 acknowledgments in all. The broad category of "Access to Research Related Information" acknowledgement topped with 46.02%, while the category of "Peer interactive communication" accounts for 23.54% of acknowledgements. The

Table 4 — Different categories of personal acknowledgements

	Number of acknowledgments (%)	Fraction of Each Category
Category 1-Access to research related information		
Access to experimental materials/specimens	43(8.04)	260(46.02%)
Access to unpublished protocols, software	3(0.56)	
Access to facilities, technology, infrastructure/equipment	214(40)	
Category 2-Access to unpublished results, data		
Provide unpublished results, data	16(2.99)	31(5.5%)
Logistics	15(2.8)	
Category 3-Peer Interactive Communication		
Provided specific /valuable suggestions	90(16.82)	133(23.54%)
Critical comments	3(0.56)	
Thanked for advice and discussions(general)	16(2.99)	
Thanked for inspiration/ encouragement/moral support	24(4.49)	
Category 4-Technical Assistance		
Thanked for performing specific analyses/procedures/ measurements	88(16.45)	93(16.46%)
Provided(unspecified) Technical Assistance	5(0.93)	
Category 5-Manuscript Preparation		
Typing/proofreading	6(1.12)	18(3.2%)
Illustrations/photographs	12(2.24)	
Total acknowledgments	535	

sub-category-"Access to facilities, technology, infrastructure/equipment" alone made up for 40% of the acknowledgments. It was also seen that authors had given due acknowledgement to either their peers or reviewers for "valuable suggestions" (16.82%) and "for performing specific analyses/procedures/ measurements" (16.45%).

Limitations

The major limitation was the inconsistency and lack of standardization of the acknowledgment text. Though the WoS reports acknowledgements since 2008, many publications do not contain any acknowledgements. It is not clear whether the lack of acknowledgment was due to non-reporting of the acknowledgements by the author or a lapse on the part of the WoS database. Terms like "support" does not exactly indicate whether financial support was also involved. Some of the papers mentioned only personal acknowledgements and not any financial support. It could be either that the research paper was not funded or that the researchers had not acknowledged the financial support. The names of countries were not specified in some records.

The lack of inconsistency in the names of funding agencies and the various schemes under these agencies also pose a problem in the analysis of the data. It was observed that though a funding agency had different schemes for eg: the University Grants Commission with the different schemes such as Junior Research Fellowship; Senior Research Fellowship, Faculty Development Programme, some records did not always indicate under which scheme the financial assistance was provided. Instead, only the name of the funding agency was provided. Hence an analysis under the different schemes of the funding agency was not done.

Conclusion

The analysis of the funding details provides insight into the funding agencies involved and the funding text helps to identify the different categories of personal acknowledgements by which the authors have expressed gratitude for the help received by others during the research process. The increase in funded publications of the University of Kerala over the years could be attributed to the shortage of financial resources, need for translation of results into practice, emphasis on academic excellence. The publications were mainly funded by external agencies and the Government sector agencies were the main source of funding in both the categories of external and internal agencies. This shows that Governments still exert a strong influence on research and innovation. University Grants Commission and the Ministry of Science of Slovenia topped among the national and external funding agencies respectively. Among the foreign countries, the United States was the main funder through its different agencies. The

research area of Geology was funded by a maximum of 25 agencies. The accounting of 46.02% of the acknowledgments in the category-"Access to Research Related Information" 23.54% in the category-"Peer Interactive Communication corroborates the idea of acknowledgments as a kind of "sub authorship". Further research can be done to understand the distribution of personal acknowledgments across subject areas.

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