Social Vulnerability and How It Matters: A Bibliometric Analysis

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Abstract: Interdisciplinary and cross-cultural studies of the impacts of environment and social vulnerability must be undertaken to address the problem of social vulnerability in the foreseeable future. Scientist or social scientists should first continuously strive towards approaches can integrate municipal technological expertise, experiences, knowledge, perceptions, and expectations into emergency circumstances, so that people can be sharper on issues and offer responses with their matters. In this paper. We performing the Bibliometric Analysis to review published papers on the keyword 'Social Vulnerability'. There are 29,468 papers published in the last 52 years from 1969 to November 2020. Disaster research by implementing the Internet of Things (IoT), data mining, machine learning is still needed.

Keywords: Social Vulnerability, Review, Bibliometric, Disaster, Mitigation.

INTRODUCTION

The disasters that have occurred during the last few years have made both developed countries and developing countries quite progressive in disaster management in the future. The workable steps include issuing state policies and applying technology that is so advanced and massive. The essence of disaster risk reduction is building the resilience of countries and communities to disasters. In principle, vulnerability analysis is used as a diagnostic tool to understand the problems and factors that cause vulnerability, a planning tool as a basis for prioritizing activities and a sequence of planned activities, a risk measurement tool to assess specific risks, and a tool for empowering and mobilizing community groups. Meanwhile, the vulnerability analysis is a part of risk analysis that enables disaster management stakeholders to manage disaster risk. The components and indicators of vulnerability are derived from the concepts, definitions, and factors that determine vulnerability. Turner *et al.*, (2003) address the question "*Who and what is vulnerable to the multiple environmental changes underway, and where? Research demonstrates that vulnerability is registered not by exposure to hazards (perturbations and stresses) alone but also resides in the sensitivity and resilience of the system experiencing such hazards*?" At this time, there are variations in the definition of vulnerability which will impact various indicators and instruments of vulnerability (Carreño, Cardona, and Barbat, 2007). Likewise, the components are extended to include physical and environmental vulnerabilities (Siagian *et al.*, 2014). Social experts agree on several main factors that affect social vulnerability (Kaban *et al.*, 2019; Nasution *et al.*, 2020) including lack of access to resources including information (Quarantelli, 1988), knowledge, and technology (Pathirage *et al.*, 2012), limited access to political power and representation (Drake, 2016), social capital (Aldrich and Meyer, 2015), social connections and networks (Caraka *et al.*, 2021; Mailfert, 2007), customs and cultural values (Anderson, 2011). Then, this paper will conduct a study on a meta-analysis of papers that have been published in the Scopus database using the keyword "social vulnerability".

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MATERIALS AND METHODS

Data Collection

In this study, publication data was taken from Scopus sources using the keyword "social vulnerability".

Data Analysis

To analyze frequently occurring keywords, the step most crucial is to measure how often words appear together relative either how often they appear separately. Besides, the correlation between words. Regarding text, the correlation between words is measured in binary form - words appear together or not. The common measure for such binary correlation is the coefficient α in Table **1** and Eq(1)

Table 1: Co-Appearing Words

	Has Word	No Word	Total
Has Word	a_{11}	a_{10}	$a_{1.}$
No Word	a_{01}	a_{00}	$a_{0.}$
Total	$a_{.1}$	$a_{.0}$	a_{total}

$$\alpha = \frac{a_{11}a_{00} - a_{10}a_{01}}{\sqrt{a_{1.}a_{0.}a_{.0}a_{.1}}} \quad (1)$$

RESULTS AND DISCUSSION

What is Vulnerability?

Vulnerability is a condition of a community or society that leads to or causes the inability to face threats of danger. Vulnerability is the level of possibility of a disaster object consisting of the community, structure, service, or geographic area experiencing damage or disturbance as a result of the impact of the disaster or the tendency of an object to be damaged by the disaster (Djalante and Thomalla, 2012; Djalante *et al.*, 2020; Djalante, Shaw and DeWit, 2020). The level of a vulnerability is an important thing to know as one of the factors that influence the occurrence of natural disasters, disasters will become a hazard if they occur in vulnerable conditions. Outline, the level of vulnerability due to the occurrence of a disaster can be viewed from 3 aspects.

First, Physical vulnerability describes the estimated level of damage to the physical if there are certain dangerous factors (Douglas, 2007). Looking at various indicators as follows: presentation of built-up areas, building density, percentage of emergency construction buildings, electricity networks, road length ratios, telecommunication networks, and railways. Second, social vulnerability shows the estimated level of vulnerability to the safety of life or health of the population in case of danger (Cutter, Boruff, and Shirley, 2003; Flanagan *et al.*, 2011). From several indicators, including population density, population growth rate. Then, Economic vulnerability is describing the amount of loss or damage to economic activities, the economic process that occurs when there is a threat of danger (Briguglio *et al.*, 2009; Bussire and Mulder, 2000; Guillaumont, 2009). Indicators that can be seen are the percentage of working households and poverty. In this study, the indicators used to measure the level of vulnerability are based solely on physical vulnerability. Indicators in measuring physical vulnerability are indicators of housing density, availability of public facilities, and critical facilities. Social vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities (Flanagan *et al.*, 2020). SoVI measured social inequality and space gaps as dimensions of social vulnerability (Kaban *et al.*, 2019).

A Global Overview on Social Vulnerability

As a result, we found 29.468 documents. It is worth noting that the keyword used “social vulnerability” is deliberately very general to broaden the overall picture of the research field under consideration but focused on high-quality journals. Figure **1** shows the number of social vulnerability publications over the 52 years; the time interval starts in 1969 (1 publication) and ends with the 3007 publications already available online in November 2020. It can be noted that from 2008 to the year 2020 there is an increasing trend of publications. Table **2** shows the sources from which the publications were taken and the total number of publications over the years; It shows that the Plos One 253 articles, Social Science and Medicine 248 articles, Sustainability Switzerland 206 articles. For more details, the readers can refer to the Table. The distribution frequency of articles, as presented in Figure **2** and Figure **3**, indicates the journals dealing with the topic and related issues. Between 2007 and 2019, it is possible to notice a significant growth in the number of publications on the topic.

As for the affiliation, in the selected sample, it was identified that the Universidade de Sao Paulo – USP is the most productive university with 320 papers, followed by the King's College London with 309

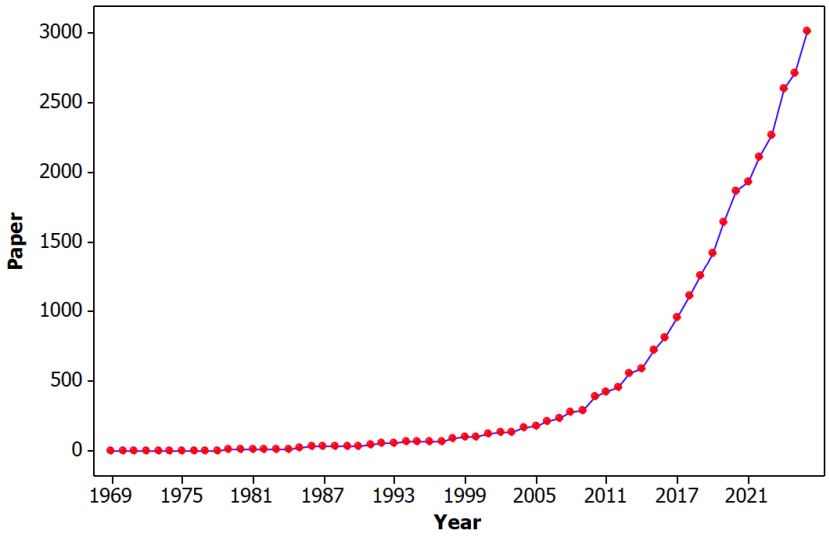

Figure 1: Publication of Paper Related to Keyword 'Social Vulnerability'.

Table 2: Top 48 Journal (Based on Mean Number of Paper=48)

SOURCE TITLE	Paper
Plos One	253
Social Science And Medicine	248
Sustainability Switzerland	206
Natural Hazards	188
International Journal Of Environmental Research And Public Health	165
International Journal Of Disaster Risk Reduction	154
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	144
Global Environmental Change	136
Ciencia E Saude Coletiva	113
Lecture Notes Of The Institute For Computer Sciences Social Informatics And Telecommunications Engineering Lnicst	113
Climatic Change	103
BMC Public Health	98
Journal Of Affective Disorders	98
Psychiatry Research	96
Psychological Medicine	94
Ecology And Society	81
International Journal For Equity In Health	81
Iop Conference Series Earth And Environmental Science	78
Regional Environmental Change	75
Encephale	73
Climate And Development	72
Culture Health And Sexuality	71
Science Of The Total Environment	71
Cadernos De Saude Publica	70
AIDS Care Psychological And Socio Medical Aspects Of AIDS HIV	67

(Table 2). Continued.

SOURCE TITLE	Paper
Schizophrenia Research	66
Environmental Science And Policy	65
Development And Psychopathology	64
Disasters	63
Psychoneuroendocrinology	57
ACM International Conference Proceeding Series	55
Advances In Intelligent Systems And Computing	55
Ocean And Coastal Management	55
Climate Change Management	54
BMJ Open	53
Risk Analysis	53
Geoforum	52
Journal Of Child Psychology And Psychiatry And Allied Disciplines	52
Saude E Sociedade	51
World Development	51
Behavioural Brain Research	50
Cognitive Therapy And Research	50
Journal Of Anxiety Disorders	50
British Journal Of Social Work	48
Child Abuse And Neglect	48
Global Public Health	48
International Journal Of Drug Policy	48
Schizophrenia Bulletin	48

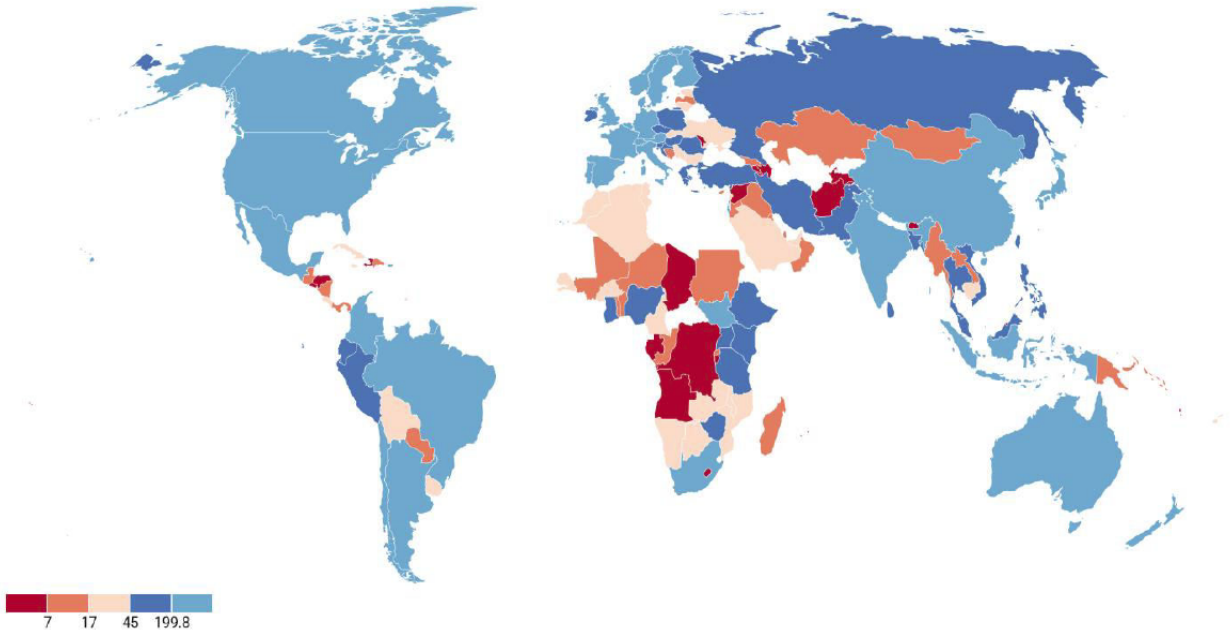

Figure 2: Distribution Frequency of Articles, Based on Quantile Equal Count.

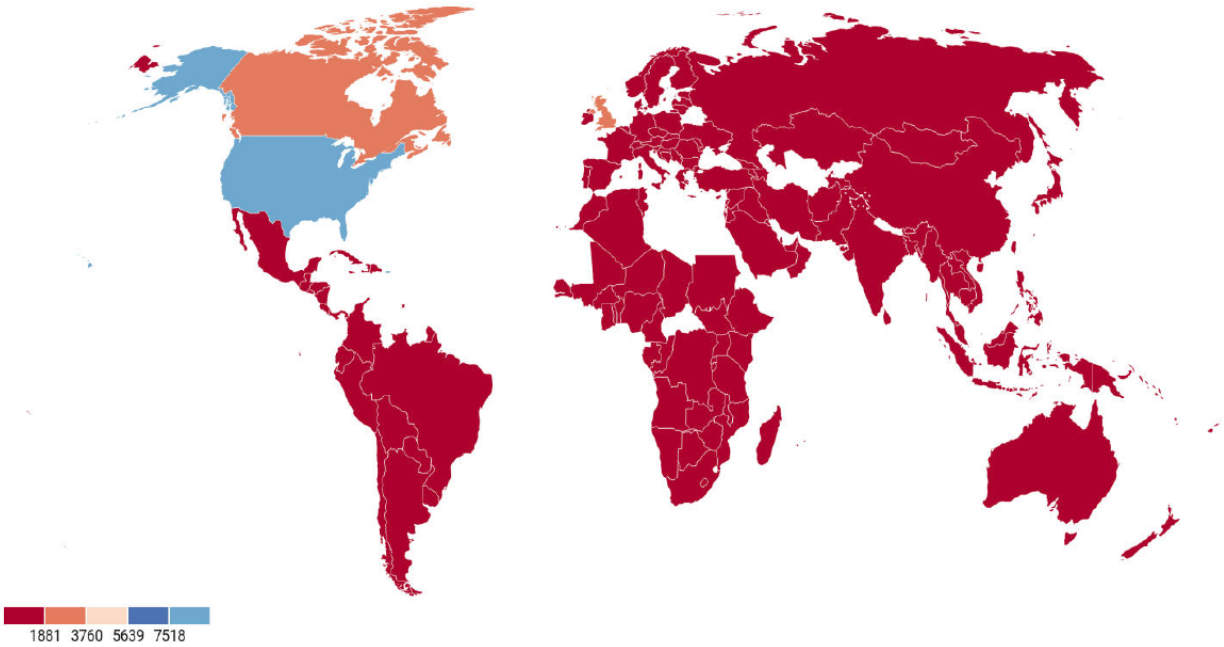

Figure 3: Distribution Frequency of Articles, Based on Count.

Table 3: Top 53 (Based on Mean Number of Paper=107)

AFFILIATION	Number Paper
Universidade de Sao Paulo - USP	320
King's College London	309
University of Toronto	292
Columbia University in the City of New York	271
University College London	270
The University of British Columbia	264
McGill University	242
University of California, Los Angeles	211
University of Melbourne	201
Inserm	200
University of New South Wales UNSW Australia	199
Harvard Medical School	197
University of Michigan, Ann Arbor	197
The University of North Carolina at Chapel Hill	193
Arizona State University	188
University of Oxford	187
University of Washington, Seattle	171
CNRS Centre National de la Recherche Scientifique	169
Fundacao Oswaldo Cruz	168
Yale University	153
The University of Queensland	148
Chinese Academy of Sciences	146

(Table 3). Continued.

AFFILIATION	Number Paper
University of California, San Francisco	146
University of California, Berkeley	146
University of East Anglia	144
Monash University	144
The University of Manchester	142
The University of Sydney	142
Johns Hopkins Bloomberg School of Public Health	141
Pennsylvania State University	139
University of Pennsylvania	138
London School of Hygiene & Tropical Medicine	136
Université de Paris	133
Harvard University	131
University of Colorado Boulder	125
University of Groningen	125
University of Cambridge	125
University of Montreal	123
University of Cape Town	122
Stanford University	121
Universidade Federal do Rio Grande do Sul	119
University of Pittsburgh	119
University of California, San Diego	117
Columbia University Irving Medical Center	114
Universidade Federal de Minas Gerais	114
VA Medical Center	113
Emory University	112
Universidad Nacional Autónoma de México	112
University of Wisconsin-Madison	111
University of KwaZulu-Natal	110
University of Leeds	109
University of Witwatersrand	107
University of Ottawa, Canada	107

scientific contributions and the University of Toronto with 292 articles. Meanwhile, Table **3** highlights the first 10 papers (with the total number of citations) ranging from 1821 to 5694 and Field-Weighted Citation Impact 3.20 to 41.88. Meanwhile, Field-Weighted Citation Impact (FWCI) is the ratio of the total citations received by the denominator's output, and the total citations that would be expected based on the average of the subject field. To Scopus database, it is sourced directly from SciVal (Schneider *et al.*, 2017; James *et al.*, 2019)

It can be seen that although there are numerous specialist journals on Social vulnerability, the most cited papers have been published mainly in Social vulnerability journals and not necessarily on Social vulnerability. This phenomenon demonstrates that

Table 4: Most Cited Paper

Authors	Title	Year	Source title	Cited by	FWCI
Albert, Jeong and Barabási, (2000)	Error and attack tolerance of complex networks	2000	Nature	5624	12.51
(Steele and Aronson, 1995)	Stereotype Threat and the Intellectual Test Performance of African Americans	1995	Journal of Personality and Social Psychology	3965	NA
(Adger, 2006)	Vulnerability	2006	Global Environmental Change	2776	25.81
(Bishop *et al*., 2004)	Mindfulness: A proposed operational definition	2004	Clinical Psychology: Science and Practice	2732	11.16
Smit and Wandel, (2006)	Adaptation, adaptive capacity, and vulnerability	2006	Global Environmental Change	2498	27.08
Cutter, Boruff, and Shirley, (2003)	Social vulnerability to environmental hazards	2003	Social Science Quarterly	2284	11.52
Schulz and Beach, (1999)	Caregiving as a risk factor for mortality: The caregiver health effects study	1999	Journal of the American Medical Association	2207	41.88
Turner *et al*., (2003)	A framework for vulnerability analysis in sustainability science	2003	Proceedings of the National Academy of Sciences of the United States of America	2171	3.20
Koob and Le Moal, (1997)	Drug abuse: Hedonic homeostatic dysregulation	1997	Science	1821	8.34

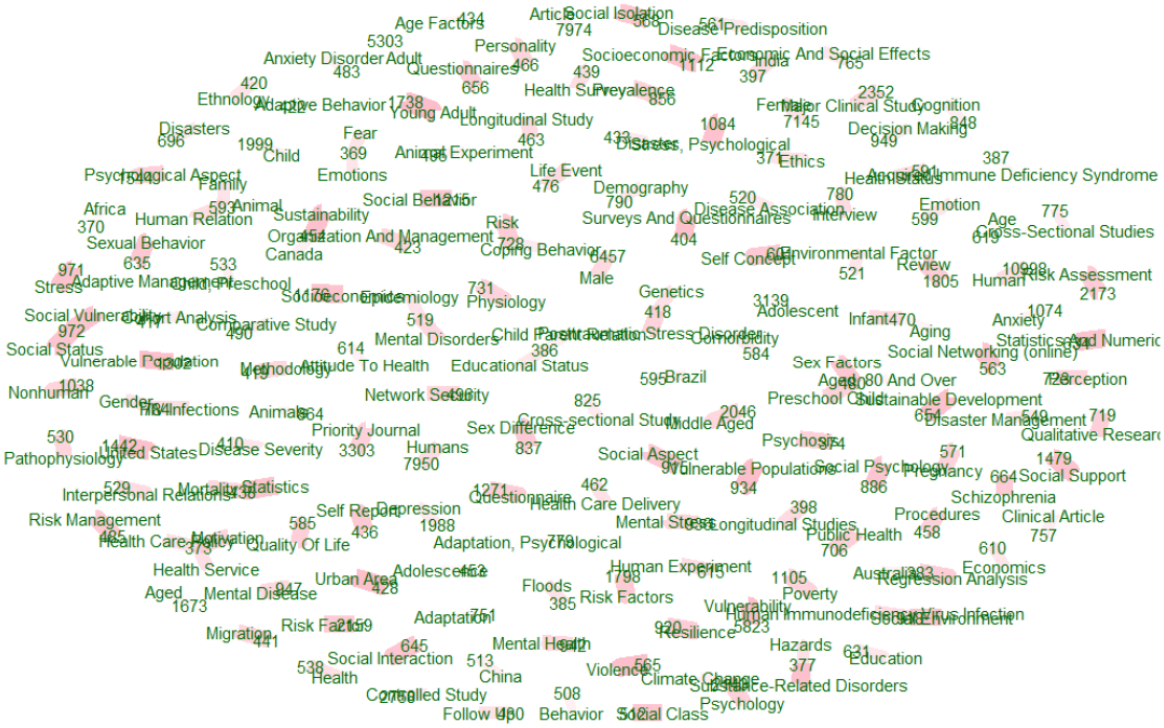

Figure 4: Cooccurrences within 3 words distance.

there is a constant growing consideration for the subject, this is apparent as indicated by the growing number of quotations per year on each article. Moreover, it can be seen that finance and the Social vulnerability and disaster are treated with different perspectives, and the elaboration plays a crucial in satisfying the research of the social vulnerability.

Figure **4** explains that authors who publish papers using the keyword Social Vulnerability also use other keywords with the most Human/Humans (18948 articles), Sex and Gender (784 articles) Female (7145 articles), and Male (6457) This article deals with the impact of vulnerability on human life. For case studies, the most widely used keywords are the United States (1442 articles), Brazil (595 articles), China (513 articles), Canada (454 articles), India (397 articles), Australia (383 articles), Africa (370 articles). Untuk topik lainnya yang banyak dibahas antara lain adalah Climate change (2143 articles), Poverty (1105 articles) Socioeconomic and Socioeconomic factors (2288 articles), stress (971 articles), mental health and mental stress (1878 articles). Berbicara topik kesehatan, keyword yang populer digunakan adalah HIV Infections (784 articles), Schizophrenia (664 articles), health status (591 articles), Pregnancy (571 articles), Disease Predisposition (561 articles), Health (538 articles), Disease association (520 articles), Epidemiology (519 articles), Health care delivery (462 articles). For the most widely used method are following: Survey and questionnaire (1675 articles), cross-sectional (825 articles), interview (780 articles), qualitative research (719 articles), Statistics and Numerical data (634 articles), longitudinal study or longitudinal studies (861 articles), Statistics (438 articles), Cohort analysis (418 articles), respectively.

CONCLUSION

There are few application topics about Big data in papers with the keyword Social vulnerability. Currently, knowledge technology, and information have developed very rapidly. Increasingly sophisticated technology enables everyone to access and obtain information quickly, without recognizing regional boundaries and time constraints. This causes information to be valuable and indispensable for decision making. One of the pieces of information needed by developed countries is information about events. natural disasters. However, the information on natural disasters currently presented is still random, difficult to understand and its validity has not been proven. Even though natural disasters are unavoidable events, the impact of disasters can be reduced or minimized by identifying the causes of disasters and studying the disaster events that have happened by analyzing existing disaster data. Also, it is necessary to predict disasters that will occur in the future so that they can become indicators of natural disaster management that will occur. Processing data into easily understandable information has been done for various purposes. Natural disaster data processing is commonly done is using big data techniques (Yu, Yang, and Li, 2018), data mining (Zheng *et al.*, 2013; Caraka *et al.*, 2020; Cios *et al.*, 2007), and IoT (Kamruzzaman *et al.*, 2017; Sakhardande, Hanagal, and Kulkarni, 2016). Big Data is an umbrella term for the explosion in the quantity and diversity of high-frequency digital data and it is not usually coming from traditional sources (Pramana *et al.*, 2017; Cenggoro *et al.*, 2019; Maroco *et al.*, 2011). The cycle in the Big Data program is divided into four. First, prevention before the occurrence of a disaster; second, anticipate when there are indications of a disaster; third, the special response in the event of a disaster; fourth, recap the disaster data. What can be done properly is by remote sensing (Syahid *et al.*, 2020; Van Westen, 2000).

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. Also, ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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