

A State-of-the-art of Scientific Research on Disinformation

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Abstract: Technological advancements in information and communications technologies and related hardware and software have positively transformed the political, military, economic and social domains in all countries around the globe. These technologies are imperfect, and States and state-sponsored threat actors are exploiting flaws in hardware and software for various types of attacks. Furthermore, the same threat actors exploit software technologies to spread disinformation and disseminate false information to mislead public opinion. This research article reviews the discourse of the scientific community on disinformation. The purpose is to understand where the research focus lies and who the researchers are the co-authors, and the publication venues. This research article reviews the scientific literature using the computational literature review, a semi-automated review method and the structural topical modelling framework to understand trends in the research. Of 3 097 documents published in 1 700 publication venues between 1974 to 2022, 704 were analysed. The results reveal 46 topics on issues such as rumours and disinformation spread during the Covid-19 pandemic, Soviet and Russian Information Warfare, and Trolls and health-related themes and effects.

Keywords: Disinformation; computational literature review; structural topic modelling; social media, trends.

1. Introduction

Technological advancements in information and communications technologies and related hardware and software have positively transformed the political, military, economic and social domains in all countries around the globe (Huskaj, 2023; UNODA, n.d.). These technologies are not without flaws. Threat actors are taking the opportunity to exploit flaws in hardware and software for espionage, attacks, and cybercriminal reasons (Huskaj, 2023). Furthermore, States and state-sponsored threat actors also exploit software technologies like social media to spread disinformation (Landon-Murray, Mujkic & Nussbaum, 2019; Hughes et al., 2021; Wawrzuta et al., 2021). The Great Soviet Encyclopaedia (the BSE) “defines disinformation as the dissemination of false information to mislead public opinion through print and radio” (in Russian: “В БСЭ дезинформация определяется как распространение через печать и радио ложных сведений с целью введения в заблуждение общественного мнения”, Litres, 2022).

In the definition, “print and radio” highlight the importance of the role of technology in disinformation. Therefore, understanding the state-of-the-art scientific research on disinformation and the focus of the research is essential for academics, policymakers, and the public. Thus, this review of the scientific literature addresses the research question, *What is the current state of scientific research on disinformation using computational topic models for review and descriptive analysis of scientific articles?*

Although previous research has provided research results into “the psychology of fake news” (Pennycook & Rand, 2021), how various social media platforms are used for disinformation (e.g., Cheung-Blunden et al., 2021; Strudwicke & Grant, 2020), and its impact (e.g., Landon-Murray, Mujkic & Nussbaum, 2019; Schirch, 2021), there is space for a comprehensive computational systematic review that reviews and synthesises the current state of scientific research on disinformation. More specifically, this computational review provides research output per year from 1974 to 2021; the top cited articles in the data set and the top publication venues; a social network analysis of researchers and their co-authors; and through topic modelling, the number of topics where word clouds visualise each topic; and finally, trend topics over time.

Although many review methods, such as a systematic literature review (e.g., Higgins et al. 2019), a meta-analysis (Chowdhury et al., 2014), and meta-synthesis (e.g., Noblit et al., 1988) exist, the CLR augments the human researcher and complements “the limitations of human data processing” (Mortenson & Vidgen, 2016, p. 1248).

2. Methods and Materials

The source for collecting research articles on disinformation was Scopus. The Scopus® database is ‘the largest abstract and citation database of peer-reviewed literature’ (Elsevier, 2018). The nature of Scopus, a database that contains curated research information in a specific format, makes it ideal for downloading and processing the information computationally. On May 31st, 2022, the keyword disinformation was used in the article title,

abstract and keywords. The database presented 3 097 document results from 1974 to 2022, published in 1 700 publication venues. Figure 1 presents published articles per year from 1974 to 2021. The documents were cleaned to remove documents without author, abstract, or doubles.

A first review of the 2 700 document results using the computational literature review (CLR) method revealed that not all results were about disinformation. Instead, some results were about disinformation in information systems, health and palaeontology. The results of the first review of the 2 700 documents using the CLR revealed 78 topics where some of the topics were about States such as America, China, the Czech Republic, Germany, Russia, and the Soviet Union. The topics included organisations such as the KGB and Stasi and “atomic agents” like “Perseus”, an alleged KGB spy who had penetrated the American “Manhattan”-project. Furthermore, the topics included propaganda, warfare, influence, and narratives. Thus, the next step was to use these topics as keywords to review what results from the Scopus-database would produce. The keywords used in the title, abstract and keywords were:

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disinformation AND ( america OR china OR czech OR german OR russia  
OR soviet OR kgb OR stasi OR propaganda OR warfare OR influence  
OR narrative* )
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The Scopus-database produced 942 document results. A manual review of the 942 document results revealed three documents being out of scope. Thus, the CLR was applied to the remaining 939 documents, spanning from 1981 to 2022 over 618 publication venues. After removing those without abstract or author, eight hundred ninety-nine (899) documents remained. After a first pass of testing, the results showed that a granular analysis had to be done. All articles from 2004 and onwards were reviewed, but the results still needed to provide more granular differences on how topics were discussed over time. Therefore, all articles (704) between 2015 to 2021 were reviewed. Figure 2 presents articles published per year between 2015-2021.

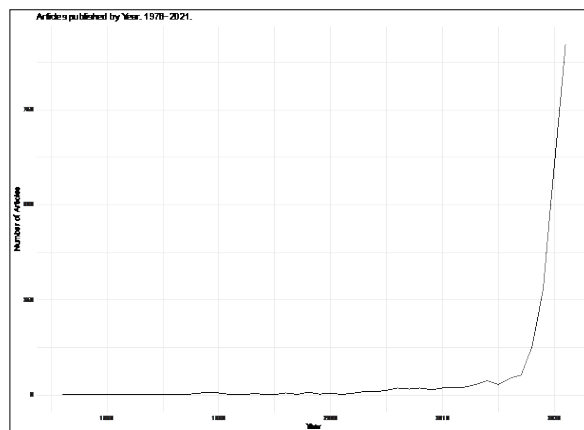


Figure 1: Research articles published per year from 1974 to 2021.

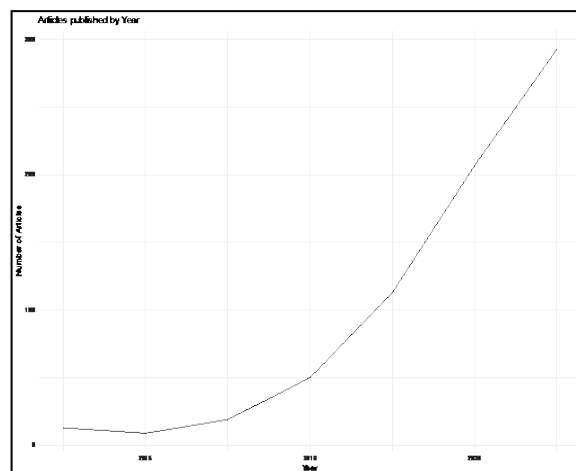


Figure 2: Research articles published per year from 2015 to 2021.

3. Results

The results from the computational literature review are publications per year (Figure 1 and Figure 2); most cited articles (Table 1); publication venues (Table 2), and social network analysis of the authors (Figure 6 and Figure 7). Topic modelling provides 46 topics which are evaluated with the word clouds and key terms. The word clouds, topics, and associated papers are presented in the supplementary material. Table 3 presents the results of the qualitative analysis of the 46 topics. Each topic is generated on the documents containing words with the highest probability being linked to that topic. Figure 7 presents trend topics over time.

Table 1: Top 5 articles ranked by citation count.

No.	Authors	Title	Year	Source	Cites
1	Hua J., Shaw R.	Corona virus (Covid-19) "infodemic" and emerging issues through a data lens: The case of China	2020	International Journal of Environmental Research and Public Health	224
2	Ahmad A.R., Murad H.R.	The impact of social media on panic during the COVID-19 pandemic in Iraqi Kurdistan: Online questionnaire study	2020	Journal of Medical Internet Research	218
3	Zellers R., Holtzman A., Rashkin H., Bisk Y., Farhadi A., Roesner F., Choi Y.	Defending against neural fake news	2019	Advances in Neural Information Processing Systems	126
4	Su Z., McDonnell D., Wen J., Kozak M., Abbas J., Šegalo S., Li X., Ahmad J., Cheshmehzangi A., Cai Y., Yang L., Xiang Y.-T.	Mental health consequences of COVID-19 media coverage: the need for effective crisis communication practices	2021	Globalization and Health	101
5	Fallis D.	What is disinformation?	2015	Library Trends	101

Table 2: The Top 5 publication venues ranked by number of articles and citation count.

Rank	Venue	Articles	Rank	Venue	Cites
1	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	22	1	International Journal of Environmental Research and Public Health	254
2	Political Communication	8	2	Political Communication	247
3	Social Media and Society	8	3	Journal of Medical Internet Research	229
4	Media and Communication	8	4	Globalization and Health	132
5	CEUR Workshop Proceedings	8	5	Proceedings of the ACM on Human-Computer Interaction	129

Table 3: The insights generated by the 46 topics identified by the algorithm.

Topic no.	Insights
1. Rumours, Disinformation, and Government Strategies during Crisis and Outbreaks	Rumours and Disinformation during COVID-19 (1.1, 1.2, 1.4, 1.12), Government Strategies and Social Media Use to Combat Disinformation (1.3, 1.5, 1.9, 1.10), Disinformation and Vulnerabilities in Different Geopolitical Contexts (1.6, 1.7, 1.8, 1.11, 1.13).
2. Russian Information Warfare and its Impact on Ukraine and the West	Historical and Cold War Perspectives on Russian Information Warfare (2.1, 2.5, 2.8, 2.11, 2.12, 2.15, 2.18), Russian Propaganda and Influence in Ukraine (2.2, 2.3, 2.10, 2.16, 2.23), Russia's Hybrid Warfare, Cyber Strategy, and Effects on the West (2.4, 2.6, 2.7, 2.9, 2.13, 2.14, 2.17, 2.19, 2.20, 2.21, 2.22).
3. Perceptions, Trust, and Effects of Online Information and Misinformation	Effects of Emotions, Repetition, and Platform Policies on Information Perception (3.4, 3.5, 3.10), Assessing Trust and Influences in Online Information and Alternative Medicine (3.1, 3.3, 3.6, 3.12), Media Practices, Astroturfing, and Access to Truthful Information (3.2, 3.7, 3.8, 3.9, 3.11).
4. Digital Democracy and Disinformation: Impacts on Law, Policy, and Public Perception	Disinformation, Manipulation, and Policy in the Digital Era (4.1, 4.3, 4.5, 4.7, 4.8, 4.9, 4.10, 4.12, 4.14, 4.16, 4.17), Legal Responses and Regulations against Disinformation (4.2, 4.11, 4.15), Ethical, Cultural, and Social Aspects of Digital Information and Public Perception (4.4, 4.6, 4.13).
5. Health Communication, Disinformation, and Public Behaviour in the Digital Age	Health Education, Communication, and Information Seeking Behaviour (5.1, 5.2, 5.3, 5.8, 5.10), Russian Trolls and Disinformation Tactics (5.4, 5.5, 5.6, 5.7, 5.9, 5.13, 5.15, 5.16), Topic Modelling and Analysing Disinformation in Various Contexts (5.11, 5.12, 5.14).
6. Digital Disinformation and its Impact on International Relations and Public Perception	Theoretical Approaches to Digital Disinformation and its Effects (6.1, 6.3, 6.8, 6.11, 6.12, 6.13), Case Studies and Regional Perspectives on Disinformation (6.2, 6.4, 6.9, 6.10, 6.14, 6.17), Digital Media, Public Relations, and Organizational Challenges (6.5, 6.6, 6.7, 6.15, 6.16, 6.18, 6.19).
7. Understanding and Countering the Effects of	User Perceptions and Susceptibility to Misinformation (7.2, 7.4, 7.8, 7.9, 7.12, 7.13), Approaches and Interventions for Countering Misinformation (7.1, 7.3, 7.6, 7.10, 7.11, 7.14, 7.15), Analysing the Effects of Misinformation and Retractions (7.5, 7.7).

Topic no.	Insights
Misinformation and Disinformation	
8. Information Warfare and Cyber Threats in a Technologically Advanced World	Theories, Frameworks, and Techniques in Information Warfare (8.1, 8.2, 8.5, 8.8), Psychological Aspects and Decision-Making in Cyber Environments (8.3, 8.4, 8.6, 8.9), Cybersecurity and Combating Disinformation (8.7, 8.10, 8.11, 8.12, 8.13, 8.14).
9. Disinformation and Communication Strategies in International Contexts	Impact of Disinformation on Global Affairs (9.1, 9.3, 9.5), Case Studies in Culture, Media, and Society (9.2, 9.4, 9.6, 9.7), Countering Disinformation and Fake News (9.8, 9.9, 9.10).
10. Knowledge Management and Disinformation in the Information Age	Effects of Disinformation and Counter-Knowledge (10.1, 10.3, 10.4), Citizen Engagement and Activism in the Digital Era (10.2, 10.5, 10.6), Historical Perspectives and Multidisciplinary Approaches (10.7, 10.8, 10.9), Artificial Intelligence, Journalism, and Combating Misinformation (10.10, 10.11, 10.12).
11. Modelling, Data Analysis, and Deception Detection	Modelling and Data Analysis (11.1, 11.8), Deception Detection and Disinformation (11.2, 11.3, 11.4, 11.6, 11.7, 11.12, 11.14, 11.15), Evaluating and Analysing Historical and Political Data (11.5, 11.10), Understanding Influence (11.9, 11.11, 11.13).
12. Misinformation, Climate Change, Media	Understanding and Analysing Discourses in Sociolinguistics and Communication (12.1, 12.8, 12.15), Disinformation, Misinformation, and Malinformation (12.2, 12.6, 12.9, 12.12, 12.16, 12.17, 12.18), Climate Change Communications, Denial, and Narratives (12.3, 12.4, 12.5, 12.11, 12.13), The Role of Media and Propaganda in Shaping Reality (12.7, 12.10, 12.14, 12.19).
13. Conspiracy Theories and Narratives during COVID-19	COVID-19 Conspiracy Theories (13.1, 13.2, 13.5, 13.10, 13.11, 13.16), Fake News, Disinformation, and the Influence on Public Beliefs and Health Guidance (13.3, 13.7, 13.8, 13.12, 13.14), Conspiracy Theories in Political and Media Contexts (13.6, 13.9, 13.13, 13.15), Conspiracy Theory Research (13.4).
14. Elections, Campaigns, and Social Media	Online Political Advertising, Disclosure, and Regulations (14.1, 14.19), Disinformation, Fake News, and the Influence on Elections and Political Campaigns (14.2, 14.7, 14.10, 14.11, 14.14, 14.16, 14.17), Election Interference, Cyber Propaganda, and Foreign Influence (14.3, 14.5, 14.9, 14.20), Sentiment Analysis and the Use of Social Media in Elections (14.8, 14.13, 14.15, 14.18), Electoral Malpractices, Ethics, and the Role of Journalism (14.4, 14.6, 14.12).
15. Deepfakes, Disinformation, and Their Influence on Individuals and Society	Deepfakes, Artificial Intelligence, and Psychological Security Threats (15.3, 15.8, 15.12), Understanding and Managing Misleading Information and Disinformation (15.1, 15.4, 15.5, 15.6, 15.9, 15.10, 15.11, 15.14, 15.15), Fake News, Deepfakes, and Their Impact on Citizen Engagement and Political Stability (15.7, 15.13, 15.14), Media Narratives (15.2).
16. The Impact of COVID-19 on Vaccine Perception and Public Health	Vaccine Hesitancy and Public Attitudes (16.1, 16.2, 16.11), Public Perceptions and Pandemic Experiences (16.3, 16.4, 16.7), Communication, Misinformation, and Infodemic (16.5, 16.6, 16.13, 16.15, 16.16, 16.19, 16.21, 16.22, 16.23, 16.24, 16.25, 16.26).
17. Dissecting Disinformation and Intent on Twitter	Detection and Analysis of Misbehaviour and Fake News (17.1, 17.4, 17.6, 17.11), Political Manipulation and Extremism through Tweets (17.2, 17.3, 17.5, 17.9, 17.10, 17.14), Disinformation Operations and Emotional Engagement (17.7, 17.12, 17.13), Discursive Characterization and Framing of Narratives on Twitter (17.8).
18. Examining Misinformation and Disinformation in Online Communities	COVID-19 Misinformation and its Global Impact (18.1, 18.3, 18.9, 18.10, 18.15, 18.18, 18.19, 18.24), Detection and Tracking of False Information on Social Media (18.2, 18.5, 18.6, 18.12, 18.21, 18.22, 18.23), The Role of Librarians and Content Moderators in Combating Misinformation (18.8, 18.19), Analysing Disinformation Campaigns and Propaganda in Social Media Networks (18.4, 18.7, 18.11, 18.13, 18.14, 18.17, 18.20).
19. Disinformation and Espionage in Historical Context	Soviet Disinformation and Espionage Cases (19.2, 19.6, 19.8, 19.10), Asbestos Industry and Misrepresentation of Health Risks (19.5), Stasi, AIDS Disinformation, and World War II (19.3, 19.6), Raoul Wallenberg and Diplomatic Controversies (19.6, 19.8, 19.10), International Espionage and Double Agents (19.7, 19.9).
20. Foreign Influence and Disinformation in Elections	Foreign Interference and Election Meddling (20.1, 20.2, 20.3, 20.7, 20.10, 20.11, 20.12), Influence Minimization and Estimation in Social Networks (20.4, 20.5, 20.6), Fake News Detection and Analysis (20.9, 20.13, 20.14), Disinformation Campaigns on Social Media Platforms (20.7, 20.15, 20.16), Case Studies of Disinformation in Elections (20.8, 20.11, 20.14).
21. Techniques and Challenges in Detecting and Classifying Misinformation and Propaganda in Multilingual Content	Multilingual and Multi-ideology Detection Techniques (21.1, 21.5, 21.9), Text Classification and Machine Learning Approaches for Misinformation Detection (21.2, 21.6, 21.7, 21.8, 21.10, 21.14), Challenges in Detecting and Defending Against Neural Fake News (21.3, 21.4, 21.11, 21.12), Identifying State-Funded News and Propaganda (21.13).
22. Addressing Hate Speech, Disinformation, and Online Regulation in the Digital Age	The Impact of Liberalism and Democratic Participation in the Digital Era (22.1, 22.5, 22.11), Legal and Regulatory Approaches to Hate Speech and Disinformation (22.2, 22.7, 22.8, 22.12, 22.13, 22.15, 22.16), Understanding and Countering Online Extremism and Disinformation Tactics (22.3, 22.4, 22.6, 22.9, 22.14), Moderation Practices and Challenges in Newsrooms and Online Platforms (22.10).
23. The Intersection of Peace, Politics, and Disinformation in Modern Society	Economic Growth and the Impact of New Frontiers (23.1), The Role of Social Media in Political Decision-Making (23.2, 23.6), Political Participation, Disinformation, and Public Infrastructure (23.3), Peace Negotiations, Referendums, and Political Opposition (23.4), The Effects of Disinformation on Journalism and Democracy (23.5), Strengthening Resilience in Political Institutions and Processes (23.7).

Topic no.	Insights
24. Understanding Social Bots and Their Impact on Information Dynamics	Detecting and Analysing Social Bots (24.1, 24.2, 24.3, 24.4, 24.10, 24.12, 24.13, 24.17), Influence and Tactics of Bots in Political and Social Contexts (24.6, 24.8, 24.11, 24.14, 24.15, 24.16, 24.18, 24.20, 24.21), Uncovering Coordinated Activities and Disinformation Networks (24.5, 24.7, 24.9, 24.19, 24.22, 24.23).
25. Deception and Manipulation in Political Communication and Propaganda	Euphemism and Deception in Political Discourse (25.1, 25.2, 25.5), Propaganda, Religion, and Literary Intelligence (25.3, 25.4), Manipulation of Information in Historical Contexts (25.6), Politics, Budgets, and Propaganda (25.7).
26. Understanding Psychological and Educational Aspects of Disinformation and Manipulation	Educational Strategies and Media Literacy (26.1, 26.4, 26.7, 26.10), Psychological Mechanisms and Implications of Disinformation, (26.2, 26.5, 26.9, 26.11, 26.12, 26.13), Cybersecurity, Digital Threats, and Countermeasures (26.3, 26.6, 26.8, 26.14).
27. Disinformation and Narrative Manipulation in European Contexts	Disinformation and Narratives in the Czech Republic and Sweden (27.2, 27.5, 27.8, 27.9, 27.15, 27.21, 27.22), Russian Influence, Propaganda, and Disinformation in Europe (27.1, 27.4, 27.10, 27.12, 27.14, 27.16, 27.17), Sociopolitical Narratives, Moral Rhetoric, and Identity (27.3, 27.6, 27.7, 27.11, 27.18, 27.19, 27.20).
28. Public Health, Misinformation, and Vaccine Hesitancy	Vaccine Refusal and Hesitancy (28.1, 28.8), Misinformation and Its Impact on Public Health and Society (28.2, 28.4, 28.5), Healthcare Access and Adaptation in Challenging Contexts (28.3, 28.9), Public Communication and Diplomacy (28.6, 28.7).
29. Russian Influence and Election Interference	Theoretical Perspectives on Interference and Democracy (29.1, 29.5, 29.6), Russian Involvement in Foreign Elections and Democratic Processes (29.3, 29.4, 29.8, 29.9, 29.13), Disinformation Campaigns and Propaganda (29.2, 29.7, 29.10, 29.11, 29.12, 29.14, 29.15, 29.16), Case Studies on Russian Influence and Disinformation (29.17, 29.18).
30. Disinformation and Content Bias on Digital Platforms	YouTube Algorithms and Vaccine Content (30.1, 30.3), YouTubeTracker and Information Operations (30.2, 30.5, 30.6), Bias and Disinformation in Video Recommendations (30.4, 30.7, 30.8), Fake News, Disinformation, and Education (30.9, 30.10, 30.11, 30.12, 30.13).
31. Propaganda, Disinformation, and Education in the Context of Cold War and Modern Conflicts	Cold War Espionage and Disinformation (31.1, 31.6, 31.7, 31.14, 31.16), Digital Literacy, Education, and Democracy (31.4, 31.9, 31.15), Media and Propaganda (31.3, 31.5, 31.8, 31.10, 31.11), Cyber Warfare and Disinformation (31.2, 31.12, 31.13).
32. Detecting and Mitigating Disinformation and Fake News in the Digital Age	Detection Techniques for Fake News and Disinformation (32.1, 32.3, 32.4, 32.6, 32.7, 32.8, 32.9, 32.10, 32.19, 32.21), Analysis, Identification, and Fact-Checking (32.2, 32.5, 32.11, 32.12, 32.13, 32.14, 32.15, 32.18, 32.20, 32.22), Cyber-Enabled Information Warfare and Propaganda (32.17), Assessing Online Information Quality for Specific Domains (32.16).
33. Understanding and Combating Disinformation and Fake News in Online Media	The Role of Trust, Source Credibility, and Motivated Reasoning (33.3, 33.8, 33.9, 33.10, 33.13, 33.14), The Impact of Disinformation on Sociopolitical Dynamics and Protests (33.1, 33.5, 33.7), Media Literacy, Critical Thinking, and Investigative Journalism (33.4, 33.6, 33.11, 33.15), Case Studies of Disinformation Campaigns and Their Effects (33.2, 33.12).
34. Disinformation and Information Warfare in Contemporary Society	Theoretical Approaches to Disinformation and Information Warfare (34.1, 34.3, 34.4, 34.13, 34.14, 34.20, 34.25), The Role of Civil Society and Government Policies in Addressing Disinformation (34.5, 34.7, 34.16, 34.19), Legal, Forensic, and Regulatory Perspectives on Disinformation (34.9, 34.10, 34.12, 34.17, 34.18, 34.21, 34.22), Case Studies on Disinformation, Propaganda, and Information Influence (34.2, 34.6, 34.8, 34.11, 34.15, 34.23, 34.24).
35. Disinformation Campaigns and Platform Use in Information Warfare	Theoretical Approaches and Assessments of Disinformation Campaigns (35.1, 35.4, 35.9, 35.14), Analysing and Tracking Coordination in Disinformation Campaigns (35.2, 35.3, 35.10, 35.12, 35.13), Case Studies of Internet Research Agency (IRA), and Propaganda Tactics (35.5, 35.7, 35.8, 35.11, 35.14, 35.15), Visual Framing and Self-Presentation in Social Media Propaganda (35.6).
36. Students, Information Literacy, and Combating Misinformation in the Digital Age	Information Literacy and Education (36.4, 36.8, 36.11, 36.12, 36.13, 36.15), Online Information Seeking, Sharing, and Consumption Habits (36.1, 36.3, 36.6, 36.7, 36.10, 36.16), Understanding and Tackling Misinformation and Fake News (36.2, 36.5, 36.9, 36.14), Information Disorders and Media Landscape during Crisis (36.5, 36.12, 36.16).
37. Digital Communication, Disinformation, and Critical Approaches in the Information Age	Digital Media, Information Literacy, and Critical Thinking (37.2, 37.6, 37.7, 37.9, 37.14), Disinformation, Information Warfare, and Cognitive Security (37.3, 37.4, 37.11, 37.12, 37.13, 37.17), Political Communication, Manipulation, and Branding in the Digital Age (37.5, 37.15, 37.18, 37.19), Comparative Studies on Disinformation Regulation and Resilience (37.1, 37.8, 37.10, 37.16).
38. Information Warfare, Disinformation, and External Threats in a Global Context	China's Cyber Coercion and Disinformation Tactics (38.1, 38.4, 38.5, 38.14), Russian Influence and Information Warfare Strategies (38.3, 38.8, 38.13), Global Dynamics of Disinformation and National Security Implications (38.2, 38.6, 38.9, 38.10, 38.11, 38.12, 38.15, 38.16, 38.17), Social Implications of Information Warfare and Defence (38.7).
39. Fact-Checking, Disinformation, and Combating Misinformation in the Spanish-speaking World and Beyond	Fact-Checking and Disinformation in Spain and Latin America (39.1, 39.2, 39.3, 39.4, 39.5, 39.8, 39.9, 39.11, 39.14, 39.15, 39.19), Social Media, Disinformation, and Fact-Checking Platforms (39.6, 39.10, 39.16, 39.17, 39.18, 39.21), Tools and Techniques for Monitoring and Combating Disinformation (39.7, 39.12, 39.13, 39.20).
40. Truth, Influence, and Disinformation in Politics and Society	Disinformation, Fake News, and Political Implications (40.2, 40.3, 40.9, 40.10, 40.11, 40.12, 40.14), Beliefs, Trust, and Values in Information Evaluation (40.5, 40.13, 40.15), Historical and Cultural Perspectives on Truth and Influence (40.1, 40.4, 40.7, 40.8).

Topic no.	Insights
41. Historical Narratives, Politics, and Media in American and Global Contexts	Historical Events and Narratives in Games and Literature (41.1, 41.5), Political Climate and Disinformation in Contemporary Societies (41.2, 41.4), Interpretative Challenges and Historical Accounts (41.3, 41.6).
42. Disinformation and Narratives in Mainstream Media and Digital Platforms	Disinformation and Opinion Leaders in Digital Media (42.2, 42.4, 42.5, 42.7), State, Society, and Disinformation Warfare (42.3, 42.6), Mainstream Media and Disinformation Analysis (42.1, 42.8, 42.9).
43. Russian Influence and Disinformation across History and Contexts	Russian Disinformation and Propaganda in Historical Context (43.1, 43.7, 43.8, 43.9, 43.12), Disinformation and Misinformation in Contemporary Society (43.2, 43.13, 43.15, 43.16, 43.17), Weaponization of Information and Targeting Specific Groups (43.3, 43.4, 43.5, 43.6, 43.10, 43.11, 43.14).
44. COVID-19 Pandemic and Disinformation Global Impact and European Perspectives	Origins and Impact of COVID-19 Disinformation (44.1, 44.5, 44.9, 44.10, 44.12), European Union and the Fight against COVID-19 Disinformation (44.7, 44.11, 44.14), Disinformation Beyond the COVID-19 Pandemic (44.2, 44.3, 44.4, 44.6, 44.8, 44.13).
45. Exploring Disinformation in the Digital Age Politics, Academia, and Online Practices	Political Aspects of Disinformation (45.1, 45.3, 45.7, 45.8, 45.9), Online Fake News and Content Analysis (45.2, 45.4, 45.6), Economic Disinformation and Recommendations (45.5).
46. The Impact of Mis- and Disinformation on Journalism	Journalists' Role Perceptions and Disinformation (46.1).

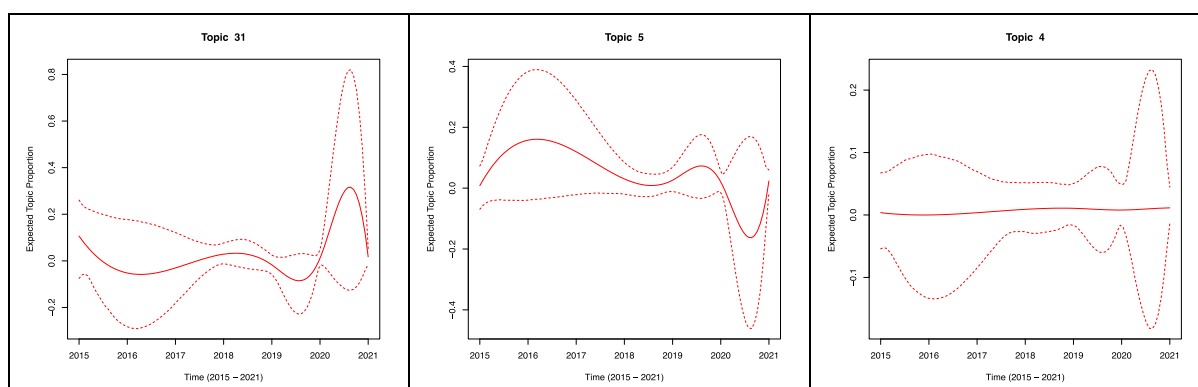


Figure 5: Trends on three topics from 2015 to 2022. Topic 31 – Propaganda, Disinformation, and Education in the Context of Cold War and Modern Conflicts; Topic 5 – Health Communication, Disinformation, and Public Behaviour in the Digital Age; Topic 4 – Digital Democracy and Disinformation: Impacts on Law, Policy, and Public Perception.

4. Discussion

The purpose of this review article was to answer the question: *What is the current state on disinformation using computational topic models for review and descriptive analysis of scientific articles?* The computational literature review and the structured topic modelling show that even though disinformation has been a topic of interest for researchers, it is first from 2016 and onwards that researchers have started to show interest on the topic. Historically, intelligence agencies such as the KGB, and STASI, have been used to conduct disinformation operations on topics like AIDS. Furthermore, researchers have shown interest in intelligence agencies and their operators’ activities in countries like Sweden, and allegedly targeting individuals such as Raoul Wallenberg.

Table 4: The domain clusters in descending order.

Domain	Topics	Domain (cont.)	Topics (cont.)
Political	7	History	3
Health	6	Combating	2
Platforms	6	Psychology & Bias	2
Context	5	Targets	2
Fields	4	AI	1
Detection	3	Impact	1
Effects	3	Source	1

Disinformation operations today are different mainly because of cyberspace. Cyberspace, the fifth domain, has increased how people generate information, do business and share and consumes information. The average citizen can access more information than states could 40 years ago. Furthermore, information about people, organisations, products, and capabilities, is readily available and pushed online rather than being pulled like 40 years ago. Finally, content based on visualised information (images, film) is much more accessible than 40 years ago. All of this is thanks to the rapid development of information- and telecommunications technologies (ICT),

increased computational power at low cost, low-cost high-storage speeds, and increased hardware and software achievements, especially within machine learning and artificial intelligence that can quickly manipulate images, film and voice: two of five senses.

So, what does all this mean? It means that as humankind is increasing interconnectedness with cyberspace through means such as virtual reality, augmented reality, and mixed reality, threat actors can exploit these new technologies and employ computational means to manipulate information spaces that align with threat actors' intent and, in turn, manipulate what humankind sees and hears. Threat actors can employ multiple avenues of approaches to achieve this goal: Exploit vulnerabilities in cyberspace; use ML/AI-enabled tools such as "deep-fakes" to impact real-world perception; state-sponsored news sites; "research"; buy stakes in companies or buy companies wholly; exploit vulnerabilities in the legal system (lawfare); create dissent between various ethnic groups; exploit religion; diseases and pandemics; use insiders, and "useful idiots". In short, manipulate information to suit the strategic security policy goals and disseminate it through multiple channels.

5. References

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