




Algorithms and communication: A systematized literature review

Algoritmos y comunicación:
Revisión sistematizada de la literatura

-  Dr. Berta García-Orosa. Professor, Department of Communication Sciences, Universidade de Santiago de Compostela (Spain) (berta.garcia@usc.es) (<https://orcid.org/0000-0001-6126-7401>)
-  Dr. João Canavilhas. Associate Professor, Department of Communication, Philosophy and Politics, Universidade da Beira Interior, Covilhã (Portugal) (jc@ubi.pt) (<https://orcid.org/0000-0002-2394-5264>)
-  Dr. Jorge Vázquez-Herrero. Assistant Professor, Department of Communication Sciences, Universidade de Santiago de Compostela (Spain) (jorge.vazquez@usc.es) (<https://orcid.org/0000-0002-9081-3018>)

ABSTRACT

The influence of algorithms on society is increasing due to their growing presence in all areas of daily life. Although we are not always aware of it, they sometimes usurp the identity of other social actors. The main purpose of this article is to address the meta-research on the field of artificial intelligence and communication from a holistic perspective that allows us to analyze the state of academic research, as well as the possible effects on these areas and on the democratic system. To this end, we carried out a systematized review of recent literature using quantitative and qualitative approaches. The subject analyzed is changing and novel: it includes the impact and interaction of algorithms, bots, automated processes, and artificial intelligence mechanisms in journalism and communication, as well as their effects on democracy. The results show expanding scientific production, mostly in English, based on theoretical discussion or focused on the perception of communication professionals. The object of study is centered mostly on journalism and democracy, and to a lesser degree on ethics or education. Studies indicate great interest in the effects of the use of algorithms on journalism and democracy, but the answers are still uncertain and the challenges for the coming years are significant.

RESUMEN

La influencia de los algoritmos en la sociedad es cada vez mayor a través de una presencia creciente en todos los ámbitos de la vida diaria, sin que seamos conscientes de ello y, en ocasiones, usurpando la identidad de otros actores sociales. El artículo tiene como propósito principal abordar la metainvestigación sobre el campo de la inteligencia artificial y la comunicación, desde una perspectiva holística que permita analizar el estado de la investigación académica, así como los posibles efectos en estas dos áreas y en la convivencia en un sistema democrático. Para ello se lleva a cabo una revisión sistematizada de la literatura reciente desde enfoques cuantitativos y cualitativos. La temática analizada es cambiante y novedosa; incluye el impacto y la interacción de algoritmos, bots, procesos automatizados y mecanismos de inteligencia artificial en el periodismo y la comunicación, así como su efecto en la democracia. Los resultados dibujan una producción científica en expansión, mayoritariamente en inglés, basada en la discusión teórica o centrada en la percepción de los profesionales de la comunicación. El objeto de estudio mayoritario se sitúa en el periodismo y en la democracia, con menor implicación de la ética o la educación. Los estudios señalan un gran interés sobre los efectos del uso de algoritmos sobre el periodismo y la democracia, pero las respuestas son todavía inciertas y los retos para los próximos años importantes.

KEYWORDS | PALABRAS CLAVE

Artificial intelligence, communication, journalism, democracy, public opinion, review.
Inteligencia artificial, comunicación, periodismo, democracia, opinión pública, revisión.

1. Introduction

Algorithms have become actors in the social, economic, political, and cultural spheres in recent years. Daily life and the decisions people make are increasingly tied to mathematical models and big data, "with varying degrees of opacity as to how they operate, in whose interest, and with what implications" (Thurman et al., 2019). Though at times algorithms may replace people's decision-making with software (Broussard et al., 2019), at other times they increase the commodification of audiences (García-Orosa, 2018), pre-designing so-called algorithmic audiences (Eldridge et al., 2019). "Algorithms have become a widespread trope for making sense of social life" (Ziewitz, 2017), and they have a greater capacity to shape the public sphere than at other times in their history (Broussard et al., 2019).

However, this situation does not exist in isolation; rather, it is part of a stage in digital communication characterized by events that are designed by the use of algorithms and that characterize the fourth wave of digital communication: digital platforms. These digital platforms have become actors in all phases of communication, the intensive use of artificial intelligence and big data, the uncritical use of technology, and the heightened striving for engagement with the audience, alongside three great challenges for democracy: a) polarization; b) fake news, deepfakes and astroturfing; and c) echo chambers and bubble filters (García-Orosa, 2022). This situation has led to noteworthy changes in the profession, in research, and in the teaching of journalism and communication, as well as in the public sphere and democratic society. The use of bots and artificial intelligence in political campaigns and referenda has been extensively studied in recent years (García-Orosa et al., 2021), with results that point not only to algorithms' direct influence on results but also towards a reconfiguration of the public sphere (Papakyriakopoulos et al., 2018; Helberger, 2019). Democracy will have to be reimagined in the new communication paradigm (Castells, 2022).

At the same time, the scientific community is taking on an object of study whose strength lies, in part, in the concealment of its functioning, identity, and objectives. The growing influence of algorithms in economic, political, social, and media systems in recent years has been accompanied by a skyrocketing increase in scientific research in those fields. We are witnessing a turning point, not only because of the changes that the pandemic has produced in communication and public opinion but, above all, because of the need to update research methods in order to make sense of an ever-changing object of study. Meta-analysis allows us to take a snapshot of scientific knowledge about an area and point out its shortcomings. In previous studies, such as the review of the scientific literature on communication in the Spanish-speaking world between 2013 and 2017 (Piñeiro-Naval & Morais, 2019), the issues addressed in this paper had yet to become influential. Currently, a literature review is needed to document milestones and forecast upcoming challenges. This article seeks to review scientific research on algorithms and communication from a holistic perspective that allows us to study their different uses in journalism and political and organizational communication, as well as their effects on these fields and democratic society. To that end, we conducted a quantitative and qualitative systematic review of recent literature.

2. Material and methods

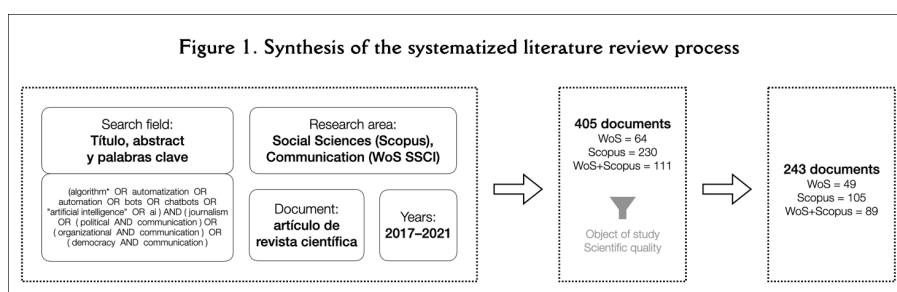
To analyze the recent scientific research on the intersection of AI and the field of communication, specifically journalism, political and organizational communication, and democracy, we conducted a systematic literature review. The study employed a systematic, scientifically-rigorous approach in the gathering, evaluation, analysis, and synthesis of data (Grant & Booth, 2009). The main objective was to evaluate the current state of research on a changing and novel topic that includes the impact and interaction of algorithms, bots, automated processes, and artificial intelligence mechanisms in journalism, political communication and organizations, as well as their effect on democracy. This frame of reference will allow us to advance current knowledge and suggest future areas of research, based on the identification of trends, strengths, and weaknesses in published studies (Shahnazi & Afifi, 2017). We developed the following research questions:

- RQ1. What are the characteristics of scientific research on artificial intelligence and communication?
- RQ2. What are the objects of study and methods employed within scientific research on artificial intelligence and communication?

- RQ3. What are the main areas of scientific research on artificial intelligence and communication?

Two scientific databases were used in the data collection phase: Web of Science (Clarivate Analytics) and Scopus (Elsevier). The selected articles include the terms in English, since the indexed publications' title, abstract, and keywords are in that language) and meet the conditions set forth in the search equation (Figure 1). The following additional inclusion criteria were considered: articles published in scientific journals, published between 2017 and 2021 (including some that were published online first), and in the categories of communication (Web of Science) and social sciences (Scopus).

The resulting set of documents consisted of 64 articles from Web of Science (SSCI), 230 articles from Scopus, and 111 articles found in both (in total, 405). In evaluating the dataset, the title, abstract, and methods were verified to apply a series of exclusion criteria based on adequacy and quality. First, we verified how each document deals with the object of study of this review, discarding the articles that did not deal with the relationship between artificial intelligence and the field of communication as defined in the search equation. Secondly, we made sure the articles met the standards of scientific rigor, though we also assumed they did because they are published in journals listed in the indicated databases. The final sample consists of 243 documents¹.



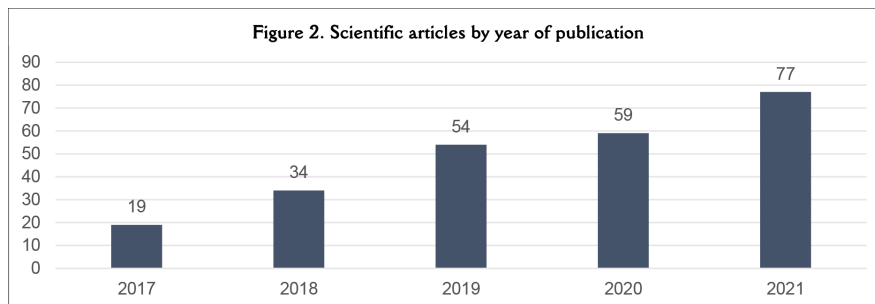
The parameters for qualitative analysis of the selected documents are presented in Table 1, which represents the systematic categorization of each article as indicated by the review guidelines (Codina, 2018), implemented manually and by a single coder. Finally, a visualization of the Scopus results ($n=194$) for the analysis of co-citation and keywords in both databases is created with the VOSviewer software. However, due to limitations in the import and export of cited references, we were not able to combine the visualization of co-citation in WoS and Scopus. Subsequently, we performed a qualitative analysis of the documents and highlighted the areas analyzed within them.

| Table 1. Article analysis variables in the systematic literature review | |
|---|--|
| Article identification | Database |
| | DOI |
| | Authorship |
| | Number of authors |
| | First signatory |
| | Authors' gender |
| | Home country of affiliated institution |
| | Title |
| | Journal |
| | Volume, number, and pages |
| | Year of publication |
| Contents | Summary |
| | Keywords |
| | Language |
| | Open access |
| | Object of study |
| Methodology | Methods used |
| Impact | Citations |
| | Co-citation |

3. Analysis and results

3.1. Bibliometric analysis

RQ1 (What are the characteristics of scientific research on artificial intelligence and communication?) was answered first. A substantial amount of research, based on 243 articles, was conducted on AI between 2017-2021. Over the years, interest has increased (Figure 2).



Articles on AI and communication were found in 97 different scientific journals, including, but not limited to, “Digital Journalism” (44 articles), “New Media & Society” (18), “Media and Communication” (12), “Journalism Practice” (10), and “Profesional de la Información” (9) (complete list in appendix¹). Most of the articles are published exclusively in English (86.4%, Table 2). The presence of Spanish-language, Russian, and Slovenian journals in the impact indices ensures the publication of articles on this subject in other languages. Open access, through the journals themselves, is available for 58.4% of the articles.

Table 2. Articles published per language and number of authors

| Language(s) | Articles | % |
|------------------------|----------|------|
| Slovenian | 4 | 1.7 |
| Spanish | 12 | 4.9 |
| Spanish and English | 9 | 3.7 |
| English | 210 | 86.4 |
| Portuguese | 2 | 0.8 |
| Portuguese and English | 5 | 2.1 |
| Russian | 1 | 0.4 |
| Authors | Articles | % |
| 1 | 89 | 36.6 |
| 2 | 73 | 30.0 |
| 3 | 52 | 21.4 |
| 4 | 23 | 9.5 |
| 5 | 4 | 1.7 |
| 6 | 2 | 0.8 |

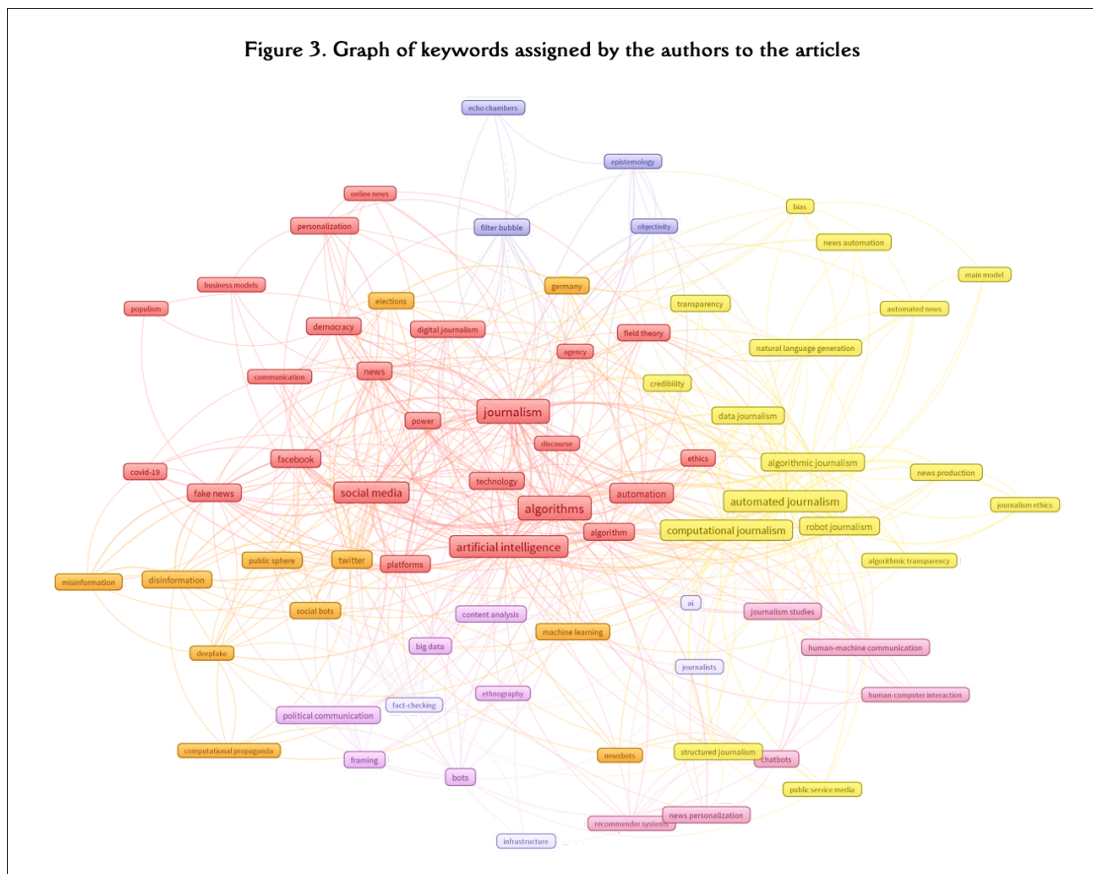
Nearly 37% percent of articles have only one author, while the majority have at least two (Table 2). Men make up 63.3% of authors, and the remaining authors are women. In 60.6% the lead author is male; however, this variable has error-inducing limitations in its coding, and in 1.4% of the articles it was not possible to determine the lead author’s gender.

The main authors, among the 9,391 identified in the co-citation analysis carried out with the documents retrieved in Scopus (n=194), are Nicholas Diakopoulos (149), Seth C. Lewis (102), Matt Carlson (95), Neil Thurman (77), Philip N. Howard (76), Chris W. Anderson (74), Natali Helberg (72), Andreas Graefe (64), Rasmus Kleis Nielsen (63), and Nic Newman (61). Therefore, the preeminent authors in the study of AI’s intersection with communication are largely from American and British universities. Appendix² presents the co-citation graph for authors with at least 20 citations, where the most frequently-cited authors make up a cluster colored in red.

The 515 authors of the articles analyzed are affiliated with institutions across 37 countries (appendix³). The top five are the United States (128; 24.9%), Spain (54; 10.5%), the United Kingdom (49; 9.5%), Germany (37; 7.2%), and the Netherlands (30; 5.8 %).

In the systematic literature review, we analyzed the articles’ objects of study to answer RQ2 (What are the objects of study and methods of scientific research on artificial intelligence and communication?). A total of 844 keywords were assigned in the articles in both WoS and Science; from the keyword graph

(Figure 3), which represents the 73 terms with a frequency greater than or equal to three, we identified seven initial clusters. The largest group (depicted in red) covers journalism, AI, algorithms, platforms, and social media. A second cluster (depicted in yellow) represents automated, robotic, and computational journalism. The third cluster (in orange) corresponds to disinformation. Among the remaining clusters, the most significant represents the field of political communication.



The keyword analysis is a first look at the object of study, which we complemented with a detailed analysis following a reading of the article. The results (Table 3) indicate that the most studied topic is the impact of artificial intelligence on journalism, taking into account its influence on news production, audiences, and the profession. Secondly, researchers studied AI's effects on the public sphere, democracy, and political communication.

To a lesser extent, researchers studied the connection between AI and web platforms, fundamentally those of social media. Other aspects analyzed are related to the rise of misinformation and fact-checking initiatives; scientific research itself, metascience and the agenda for future research; the impact on communication and organization management; ethical and regulatory issues; and education and digital literacy.

Regarding the methods used (Table 3), a significant number of articles (26.7%) focus on a theoretical-conceptual discussion without an explicit methodology, which can be added to the set of literature reviews (5.4% of articles) to form a group of theoretical articles. Researchers employed various methodologies in studying artificial intelligence in the field of communication, with a focus on the perception of practitioners, experts, and consumers in numerous studies, as seen in interviews, surveys, and focus groups (21.3%).

Data analysis methods (14.2%), generally applied to social networks, have a specific value due to the significant connection between platforms and algorithms. Content analysis, both quantitative and qualitative, is the fourth most commonly-employed methodology, followed by case studies. Other

methodological approaches appear less frequently, such as experiments, field work, methodological discussion, and participatory research.

Table 3. The articles' objects of study and methodologies

| Object of study | Articles | % |
|---|----------|------|
| Journalism | 90 | 37.0 |
| Production | 45 | 18.5 |
| Profession | 16 | 6.6 |
| Audiences | 29 | 11.9 |
| Public sphere, democracy, and political communication | 56 | 23.0 |
| Platforms | 44 | 18.1 |
| Disinformation and fact-checking | 15 | 6.2 |
| Research | 15 | 6.2 |
| Communication and management in organizations | 11 | 4.5 |
| Ethics and regulation | 8 | 3.3 |
| Education and literacy | 4 | 1.6 |
| Method | Articles | % |
| Theoretical discussion (unspecified method) | 64 | 26.7 |
| Data analysis | 34 | 14.2 |
| Interviews | 33 | 13.8 |
| Content analysis | 29 | 12.1 |
| Case study | 27 | 11.3 |
| Experiment | 21 | 8.8 |
| Poll | 16 | 6.7 |
| Literature review | 13 | 5.4 |
| Field work | 9 | 3.8 |
| Others | 9 | 3.8 |
| Methodological discussion | 5 | 2.1 |
| Participatory research | 3 | 1.3 |
| Focus group | 2 | 0.8 |

Note. The method could not be coded for three inaccessible articles.

The impact of the articles reviewed is limited by the short amount of time since publication, since the period covered is 2017-2021. Still, the articles are frequently cited, with an average of 12 citations each, in a total of 2,913. Appendix 4 lists the ten most frequently-cited articles according to the databases consulted, whose authors include 20 men and 7 women⁴.

3.2. Qualitative interpretation: From news production to pre-constructed audiences

Algorithms have been used in scientific literature for data extraction and interpretation, especially in content analysis and experiments (Broersma & Harbers, 2018; Yarchi et al., 2020). However, in recent years, algorithms themselves have become an object of study, either because of their influence on some of the traditional actors in politics, economy, society, or culture, or because of their role as political actors.

This section is structured based on the qualitative results of the systematic review of the literature carried out to answer RQ3 (What are the main areas of scientific research on artificial intelligence and communication?). Research in recent years has centered on several main narratives: the influence of algorithms on democracy, the effects of algorithms on the media and audiences, and the significance of algorithmic determination of consumption. The following is a review of the approach and results of the studies conducted on these topics.

3.2.1. Influence on democracy

As noted in the introduction, the literature indicates that the widespread use of algorithms greatly influences the functioning of democratic political systems, and that bots' influence also continues to grow (Montal & Reich, 2017; Santini et al., 2018), especially during campaign season. Research on this topic focuses on a technical definition of algorithms and primarily seeks to develop detection systems through machine learning (Häring et al., 2018; Dubois & McKelvey, 2019). Meanwhile, in the social sciences, researchers question the health of democracy due to the spread of fake news (Bimber & Gil-de-Zúñiga, 2020), as well as astroturfing campaigns that can manipulate and sow uncertainty (Zerback et al., 2021).

Today, doubt has been cast on some concepts that were otherwise widely accepted in recent years, such as bubble filters (Puschmann, 2019). Some studies indicate that social media reinforce existing attitudes (Ohme, 2021). Others discuss social media's influence on the public sphere (Kaluža, 2021). There also are studies that question the validity of the term. Haramba et al. (2018) propose a historical interpretation from the perspective of the commodification of readership (García-Orosa, 2018). The goal of satisfying readers' habits, even with false, misleading, or biased information, stems from the attention

economy and is a fundamental principle of algorithms that satisfies users by captivating them (Seaver, 2018). In this sense, Schjøtt-Hansen and Hartley (2021) analyze algorithms and news selections to describe the evolution from distributing news content to readers/viewers treated as segments of consumer groups to algorithmically constructing individual readers/viewers as aggregate data points.

After a decade of euphoria about platforms' potential to empower citizens, disinformation, fake news, incitement to hatred and the Cambridge Analytica scandal, among others, have engendered mistrust (van-Dijck, 2020). Scientific literature highlights the risks in algorithms' potential to slander and the defenselessness of the media and citizens, as pointed out by Lewis et al. (2019). The authors draw attention to two relevant issues: the difficulty in finding guilty parties in defamation cases and in finding defenses as powerful as those wielded by the platforms.

These influences on democracy have led some authors to speak of "algorithmic culture" (Gilbert, 2018) and potential threats to democratic values. In recent years, scholars have called for legislative reforms to address the new challenges that online communication poses for democratic values or specific issues such as legislation on bots (Jones & Jones, 2019), privacy and facial recognition (Leong, 2019), or incidences of racism caused by algorithms (Turner-Lee, 2018).

3.2.2. Journalism and media

State-of-the-art technology has affected the practice of journalism in recent years (López-García & Vizoso, 2021), and the use of algorithms has sparked debates about the industry's core definition and foundation. Researchers have coined different names for the use of algorithms, (Vállez & Codina, 2018) among which automated, algorithmic, or robot journalism are the most used. Under this label, scholars have analyzed, fundamentally from the perspective of journalists and media directors themselves, the consequences of the implementation and use of algorithms in the production, distribution, and circulation of information.

In recent years, a growing number of media outlets, such as The Associated Press, The Washington Post, and the BBC, have embraced "automated journalism," (Graefe, 2018), also known as "algorithmic journalism" (Kotenidis & Veglis, 2021) or "robot journalism" (Waddell, 2018), understood as the automatic generation of journalistic texts through software and algorithms, with little or no human intervention, except for the initial programming (Danzon-Chambaud & Cornia, 2021; Sehl et al., 2021). Nonetheless, algorithms also intervene in the phase of selecting the issue, sources, and circulation of the journalistic message. Automation is studied from the perspective of helping journalists, for example, in the search for newsworthy events (Diakopoulos et al., 2021; Thurman et al., 2017), in personalized distribution by news recommendation systems (Helberger, 2019), in promoting data journalism (Tong & Zuo, 2021), in evaluating the credibility of sources (Fletcher et al., 2020; Graefe et al., 2018), or in redefining news values (Choi, 2019).

Overall, the results reveal the transformative role of machines, especially in the news-gathering and distribution phases, and increasingly in the writing phase, especially in data-rich specialties such as sports and economics. However, journalists continue to control all phases of the news production process (Milosavljevi & Vobi, 2019), especially in the news selection and editing phases, suggesting a desire to protect their role as final arbiters of meaning (Wu et al., 2019). Several authors have studied the potential for the robotization of journalism (Borges & Gambarato, 2019; Dierickx, 2021), and some have concluded that robots do not threaten their work (De-la-Torre, 2020).

As changes in the profession come to light, a significant re-working of the logic of journalism is leading to a new conceptualization of the field and technology's influence on it. The studies examine automation as one element of journalists' work (Calvo-Rubio & Ufarte-Ruiz, 2020) and identify contradictions between automation and some of the fundamental ideals of journalism, like public service, autonomy and objectivity (Milosavljevi & Vobi, 2019), which leads to friction when implemented in newsrooms (Hermida & Young, 2017). Journalists point to the nature of the sources and robots' lack of a "nose for news" as some of the limitations of automated journalism (Thurman et al., 2017).

After the period of 2015 to 2016, which was partly characterized by a very favorable and uncritical attitude, the most recently published texts (2017-2019) once again opted for the neutral tone typical

of 2011 and 2012 (Parratt-Fernández et al., 2021). Research has emerged that questions the role of journalism within society and the consequences of algorithmizing the profession, as well as social, economic, political, and cultural life, and attempts to re-imagine the field (Bucher, 2017) and analyze challenges centered on ethics (Dörr & Hollnbuchner, 2017) and credibility (Tandoc et al., 2020). Such studies describe algorithmic journalism and new challenges in the fight against the dominance of commercial interests (more visible in outlets' business departments than in newsrooms) in the implementation of automation (Slaek-Brlek et al., 2017).

Other authors highlight the growing dependence on software providers and platforms in the face of editorial independence, which should prevail in journalism (Schapals & Porlezza, 2020; Weber & Kosterich, 2018), due to the role of professionals, such as technologists, i.e., computer scientists or "technoactors," new to the (Canavilhas et al., 2016) production processes, who influence the news and redefine journalism with their practices and values (Wu et al., 2019).

3.2.3. Audience

Automation has sparked new debates on the production of journalistic texts and their authorship (Montal & Reich, 2017), and in some situations it is no longer possible to determine who produces the news (Völker & Powell, 2021). Moreover, automation has also changed journalists' relationships with the audience, for example, through the use of newsbots as mediators between journalist and audience (Ford & Hutchinson, 2019). Since the beginning of online journalism, the audience has been part of the journalist's work (García-Orosa, 2018), but the use of algorithms is a step forward that has two implications. First, through audience monitoring, "[...] journalists can—and do—monitor social network users and their content via sophisticated, professional apps that are also used by police and security forces. (Thurman, 2018: 1). Secondly, journalists can create algorithmic audiences in line with the interests of news outlets. Martin (2021) warns of the risks of the mediatization of news visibility through opaque algorithms, as well as through the platformization of news (van-Dijk et al., 2018) and the metrification of news values.

Algorithms not only influence what content is featured; the audience is also ranked according to their interest in the platform. Regarding Facebook, Thorson et al. (2021) suggest that people who are algorithmically categorized as interested in news or politics are more likely to attract content to their feeds, regardless of their self-reported interest in civic content. In this sense, Papakyriakopoulos et al. (2018) discuss the relevance of hyperactive users (users with above-average activity on the network) in shaping public opinion and democracy. The authors study their influence, which affects public opinion on social networks, and warn of the possible adverse consequences of algorithms and recommendation systems for political systems. Therefore, one of the most important aspects is circulation. Media outlets have gone from disseminating content to audiences and managing their activities, to transforming the audience into constructors of the discourse and creating algorithmic audiences based on previously-obtained big data. Bodó (2019) describes how European media, instead of focusing on increasing user engagement in the short term, try to personalize the news to increase audience loyalty in the long term. "Unlike the 'platform logic of personalization', which uses personalization to produce engagement and sell audiences to advertisers, they have developed a 'news logic of personalization' that uses personalization to sell news to audiences. (Bodó, 2019: 1054).

New social, political, and media roles are conquering spaces as algorithms, a generalized trope to give meaning to social life (Ziewitz, 2017), which not only shapes the agenda, but also constructs the audience (Thorson et al., 2021). The media seek an audience that is "constructed" rather than a naturally arising one (Eldridge et al., 2019). As such, algorithmic audiences are programmed (Møller-Hartley et al., 2021) to promote a "particularly populist 'profitable and normal' media experience" (Harper, 2017). Users are often defenseless because they are unaware of how news are filtered and prioritized (Powers, 2017) and how the user profile is predicted.

3.2.4. Algorithmic determination of consumption

Literature highlights recommendation systems as shapers of public opinion and, therefore, of civic participation in public life. The massive consumption of information on social media platforms, which has

dealt a blow to traditional media, has led to a significant dependence on the algorithmic determination of news consumption based on previous audience behavior, analyzed through big data, and possible distortions such as polarization (Shmargad & Klar, 2020). News personalization systems are viewed as black boxes that indicate a significant disconnection between the practice and theory of algorithmic transparency, particularly in non-community contexts (Bastian et al., 2021). The use of different data sources to predict what content will be interesting to readers raises concerns about possible audience fragmentation (Makhortykh & Wijermars, 2021); after tracking news personalization for six years and detecting platform commodification, Kunert and Thurman (2019) also raised concerns about data protection and the effects of recommendation systems.

But there are also traditional media projects that use news recommendation systems transparently to combat disinformation and create a European public sphere, which seems to be confirmed by an analysis of the news they have produced (Canavilhas, 2022). Such is the case of the European Broadcasting Union's "A European Perspective," whose PEACH ecosystem seeks to offer the most appropriate content to each user at the most opportune time and on the most appropriate device. The system highlighted by recent academic literature sparks an important debate on the opacity of recommendation and content adaptation systems and, therefore, on their role in democratic systems (Helberger, 2019).

4. Discussion and conclusions

In a fluid and hybrid context, algorithms stand out as new actors in communication and political, economic, and social systems. Their influence, often based on the use of confidential personal data or the concealment or theft of digital identities, has increased in recent years, resulting in more and more disinformation campaigns that use algorithms and bots to achieve a greater and faster impact.

News organizations have adapted in various ways to a digital media environment dominated by algorithmic gatekeepers like search engines and social media (Graves & Anderson, 2020). Communicative robots are defined as autonomously operating systems designed for the purpose of quasi-communicating with humans to enable other algorithm-based functionalities, often based on artificial intelligence such as Siri or Alexa (Hepp, 2020).

Quantitatively, scientific research on the intersection of artificial intelligence and communication increased significantly from 2017-2021. Most articles are published in English and have several authors. The United States, Spain, and the United Kingdom have the greatest presence in our review. The objects of study address the different perspectives of these two interacting fields, though the most common issues are the field of journalism, whether in terms of production, the profession itself, or the audiences; the impact on the public sphere, democracy, and political communication; and the role of algorithms on platforms. Methodologically speaking, researchers have employed a range of methods and techniques to study the phenomenon at hand, including but not limited to, theoretical-conceptual discussions without an explicit methodology; studying the perspective of key players; and analyzing data obtained from platforms.

From a qualitative point of view, the scientific literature on algorithms and communication describes an uncertain situation that is difficult to analyze due to algorithms' typical lack of transparency. Researchers addressed how algorithms work from an engineering and computer science standpoint, and showed their concern about how journalism implements algorithms as well as the effects on audiences and democracy. The results must be confirmed with future research on how different figures in democracy are enhanced or assisted, taking culture into account, among other factors (Jamil, 2021).

There will be myriad challenges in the coming years. Below are some that our analysis has revealed:

- The search for specific methodologies and analytical methods that allow us to understand a changing and opaque reality.
- Promotion of multidisciplinary research.
- Empirical studies on the effects of using algorithms in different systems.
- Promotion of comparative analyses between different countries that advance the state of knowledge through generalizable data.

5. Limitations

This is a literature review of research that already has its own epistemic and methodological biases. The search formula leads to limited results; we had to limit the field to the intersection of artificial intelligence with journalism, political communication, organizational communication, and democracy, because the inclusion of the term “communication” interfered with the data. In addition, because artificial intelligence is inherently opaque, the narrative espoused by key players in the media becomes salient, with the validity and bias that this implies.

Notes

¹Dataset available at: <https://doi.org/10.6084/m9.figshare.19411187>.

²Graph of co-citation of bibliographic references per author: <https://doi.org/10.6084/m9.figshare.19632741.v1>.

³Map of authors by country of affiliated institution: <https://doi.org/10.6084/m9.figshare.19632759>.

⁴List of the ten most cited articles of the systematized literature review: <https://doi.org/10.6084/m9.figshare.19632762>.

Authors' Contribution

Idea, B.G.O., J.C.; Literature review (state of the art), B.G.O.; Methodology, J.V.H., B.G.O.; Data analysis, J.V.H.; Results, J.V.H., B.G.O.; Discussion and conclusions, B.G.O., J.C., J.V.H.; First draft, B.G.O., J.V.H.; Final revisions, B.G.O., J.C., J.V.H.; Project design and sponsorships, B.G.O.

Funding Agency

This research has supported by Radón en España: percepción de la opinión pública, agenda mediática y comunicación del riesgo – RAPAC (SUBV-13/2021; Consejo de Seguridad Nuclear).

References

- Bastian, M., Helberger, N., & Makhortykh, M. (2021). Safeguarding the journalistic DNA: Attitudes towards the role of professional values in algorithmic news recommender designs. *Digital Journalism*, 9(6), 835-863. <https://doi.org/10.1080/21670811.2021.1912622>
- Bimber, B., & Gil-De-Zúñiga, H. (2020). The unedited public sphere. *New Media and Society*, 22(4), 700-715. <https://doi.org/10.1177/1461444819893980>
- Bodó, B. (2019). Selling news to audiences - A qualitative inquiry into the emerging logics of algorithmic news personalization in European quality news media. *Digital Journalism*, 7(8), 1054-1075. <https://doi.org/10.1080/21670811.2019.1624185>
- Borges, P.M., & Gambarato, R.R. (2019). The role of beliefs and behavior on Facebook: A semiotic approach to algorithms, fake news, and transmedia journalism. *International Journal of Communication*, 13, 603-618. <https://bit.ly/3MgzAp6>
- Broersma, M., & Harbers, F. (2018). Exploring machine learning to study the long-term transformation of news: Digital newspaper archives, journalism history, and algorithmic transparency. *Digital Journalism*, 6(9), 1150-1164. <https://doi.org/10.1080/21670811.2018.1513337>
- Broussard, M., Diakopoulos, N., Guzman, A.L., Abebe, R., Dupagne, M., & Chuan, C.H. (2019). Artificial intelligence and journalism. *Journalism and Mass Communication Quarterly*, 96(3), 673-695. <https://doi.org/10.1177/1077699019859901>
- Bucher, T. (2017). 'Machines don't have instincts': Articulating the computational in journalism. *New Media and Society*, 19(6), 918-933. <https://doi.org/10.1177/1461444815624182>
- Calvo-Rubio, L.M., & Ufarte-Ruiz, M.J. (2020). Perception of teachers, students, innovation managers and journalists about the use of artificial intelligence in journalism. *Profesional de la Información*, (1), 29-29. <https://doi.org/10.3145/epi.2020.ene.09>
- Canavilhas, J. (2022). Artificial intelligence in journalism: Automatic translation and recommendation system in the project “A European Perspective” (EBU). *Revista Latina de Comunicación Social*, 80, 1-13.
- Canavilhas, J., Satuf, I., Luna, D., Torres, V., Baccin, A., & Marques, A. (2016). Jornalistas e tecnoatores: A negociação de culturas profissionais em redações on-line. *Revista Famecos*, (3), 23-23.
- Castells, M. (2022). Digital politics: A paradigm shift. In B. García-Orosa (Ed.), *Digital political communication strategies. Multidisciplinary reflections* (pp. 5-7). Palgrave. <https://doi.org/10.1007/978-3-030-81568-4>
- Choi, S. (2019). An exploratory approach to the computational quantification of journalistic values. *Online Information Review*, 43(1), 133-148. <https://doi.org/10.1108/OIR-03-2018-0090>
- Codina, L. (2018). *Revisión bibliográfica sistematizada: Procedimientos generales y framework para ciencias humanas y sociales*. [Master dissertation, Universitat Pompeu Fabra]. <https://bit.ly/3L7vMGz>
- Danzon-Chambaud, S., & Cornia, A. (2021). Changing or reinforcing the “rules of the game”: A field theory perspective on the impacts of automated journalism on media practitioners. *Journalism Practice*. <https://doi.org/10.1080/17512786.2021.1919179>
- De-La-Torre, J. (2020). Los periodistas no creen que la Inteligencia Artificial pueda sustituirlos. *Escudo digital*. <https://bit.ly/3L7mDht>
- Diakopoulos, N., Trielli, D., & Lee, G. (2021). Towards understanding and supporting journalistic practices using semi-automated news discovery tools. In J. Nichols (Ed.), *Proceedings of the ACM on Human-Computer Interaction* (pp. 1-30). Association for Computing Machinery. <https://doi.org/10.1145/3479550>

- Dierickx, L. (2021). News automation, materialities, and the remix of an editorial process. *Journalism*. <https://doi.org/10.1177/14648849211023872>
- Dörr, K.N., & Hollnbuchner, K. (2017). Ethical challenges of algorithmic journalism. *Digital Journalism*, 5(4), 404-419. <https://doi.org/10.1080/21670811.2016.1167612>
- Dubois, E., & Mckelvey, F. (2019). Political bots: Disrupting Canada's democracy. *Canadian Journal of Communication*, 44(2), 27-34. <https://doi.org/10.22230/cjc.2019v44n2a3511>
- Eldridge, S.A., García-Carretero, L., & Broersma, M. (2019). Disintermediation in social networks: Conceptualizing political actors' construction of publics on Twitter. *Media and Communication*, 7, 271-285. <https://doi.org/10.17645/mac.v7i1.1825>
- Fletcher, R., Schifferes, S., & Thurman, N. (2020). Building the 'Truthmeter': Training algorithms to help journalists assess the credibility of social media sources. *Convergence*, 26(1), 19-34. <https://doi.org/10.1177/1354856517714955>
- Ford, H., & Hutchinson, J. (2019). Newsbots that mediate journalist and audience relationships. *Digital Journalism*, 7(8), 1013-1031. <https://doi.org/10.1080/21670811.2019.1626752>
- García-Orosa, B. (2018). Perfil de la audiencia de cibermedios: representación discursiva y praxis del receptor 2.0. *Palabra Clave*, 21, 111-133. <https://doi.org/10.5294/pacla.2018.21.1.6>
- García-Orosa, B. (2022). Digital political communication: Hybrid intelligence, algorithms, automation and disinformation in the fourth wave. In B. García-Orosa (Ed.), *Digital Political Communication Strategies*. Palgrave. <https://doi.org/10.1007/978-3-030-81568-4>
- García-Orosa, B., Gamallo, P., Martín-Rodilla, P., & Martínez-Castaño, R. (2021). Hybrid intelligence strategies for identifying, classifying and analyzing political bots. *Social Sciences*, 10(10). <https://doi.org/10.3390/socsci10100357>
- Gilbert, A.S. (2018). Algorithmic culture and the colonization of life-worlds. *Thesis Eleven*, 146, 87-96. <https://doi.org/10.1177/0725513618776699>
- Graefe, A., Haim, M., Haarmann, B., & Brosius, H.B. (2018). Readers' perception of computer-generated news: Credibility, expertise, and readability. *Journalism*, 19(5), 595-610. <https://doi.org/10.1177/1464884916641269>
- Grant, M.J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, 26, 91-108. <https://doi.org/10.1111/j.1471-1842.2009.00848.x>
- Graves, L., & Anderson, C.V. (2020). Discipline and promote: Building infrastructure and managing algorithms in a "structured journalism" project by professional fact-checking groups. *New Media and Society*, 22(2), 342-360. <https://doi.org/10.1177/1461444819856916>
- Håring, M., Loosen, W., & Maalej, W. (2018). Who is addressed in this comment? Automatically classifying meta-comments in news comments. In K. Karahalios, A. Monroy-Hernández, A. Lampinen, & G. Fitzpatrick (Eds.), *Proceedings of the ACM on Human-Computer Interaction* (pp. 1-20). <https://doi.org/10.1145/3274336>
- Harper, T. (2017). The big data public and its problems: Big data and the structural transformation of the public sphere. *New Media and Society*, 19(9), 1424-1439. <https://doi.org/10.1177/1461444816642167>
- Helberger, N. (2019). On the democratic role of news recommenders. *Digital Journalism*, 7(8), 993-1012. <https://doi.org/10.1080/21670811.2019.1623700>
- Hepp, A. (2020). Artificial companions, social bots and work bots: communicative robots as research objects of media and communication studies. *Media, Culture and Society*, 42(7-8), 1410-1426. <https://doi.org/10.1177/0163443720916412>
- Hermida, A., & Young, M.L. (2017). Finding the data unicorn: A hierarchy of hybridity in data and computational journalism. *Digital Journalism*, 5(2), 159-176. <https://doi.org/10.1080/21670811.2016.1162663>
- Jamil, S. (2021). Automated journalism and the freedom of media: Understanding legal and ethical implications in competitive authoritarian regime. *Journalism Practice*. <https://doi.org/10.1080/17512786.2021.1981148>
- Jones, R., & Jones, B. (2019). Atomising the news: The (in)flexibility of structured journalism. *Digital Journalism*, 7(8), 1157-1179. <https://doi.org/10.1080/21670811.2019.1609372>
- Kaluža, J. (2021). Habitual generation of filter bubbles: Why is algorithmic personalisation problematic for the democratic public sphere? *Javnost*. <https://doi.org/10.1080/13183222.2021.2003052>
- Kotenidis, E., & Veglis, A. (2021). Algorithmic journalism-Current Applications and Future Perspectives. *Journalism and Media*, 2(2), 244-257. <https://doi.org/10.3390/journalmedia2020014>
- Kunert, J., & Thurman, N. (2019). The form of content personalisation at mainstream, transatlantic news outlets. *Journalism Practice*, 13(7), 759-780. <https://doi.org/10.1080/17512786.2019.1567271>
- Leong, B. (2019). Facial recognition and the future of privacy: I always feel like... somebody's watching me. *Bulletin of the Atomic Scientists*, 75(3), 109-115. <https://doi.org/10.1080/00963402.2019.1604886>
- Levis, S.C., Guzman, A.L., & Schmidt, T.R. (2019). Automation, journalism, and human-machine communication: Rethinking roles and relationships of humans and machines in news. *Digital Journalism*, 7(4), 409-427. <https://doi.org/10.1080/21670811.2019.1577147>
- López-García, X., & Vizoso, A. (2021). Periodismo de alta tecnología: Signo de los tiempos digitales del tercer milenio. *Profesional de la Información*, (pp. 30-30). <https://doi.org/10.3145/epi.2021.may.01>
- Makhortykh, M., & Wijermars, M. (2021). Can filter bubbles protect information freedom? Discussions of algorithmic news recommenders in Eastern Europe. *Digital Journalism*. <https://doi.org/10.1080/21670811.2021.1970601>
- Martin, F.R. (2021). Visibility, connectivity, agency: Journalism's prospects in an age of automated social news sharing. *Digital Journalism*, 9(8), 1190-1198. <https://doi.org/10.1080/21670811.2021.1977670>
- Milosavljevi, M., & Vobi, I. (2019). Human still in the loop: Editors reconsider the ideals of professional journalism through automation. *Digital Journalism*, 7(8), 1098-1116. <https://doi.org/10.1080/21670811.2019.1601576>
- Møller-Hartley, J., Bengtsson, M., Hansen, A.S., & Sivertsen, M.F. (2021). Researching publics in datafied societies: Insights from four approaches to the concept of 'publics' and a (hybrid) research agenda. *New Media and Society*.

- <https://doi.org/10.1177/14614448211021045>
- Montal, T., & Reich, Z. (2017). I, robot. You, journalist. Who is the author? Authorship, bylines and full disclosure in automated journalism. *Digital Journalism*, 5(7), 829-849. <https://doi.org/10.1080/21670811.2016.1209083>
- Ohme, J. (2021). Algorithmic social media use and its relationship to attitude reinforcement and issue-specific political participation-The case of the 2015 European immigration movements. *Journal of Information Technology and Politics*, 18(1), 36-54. <https://doi.org/10.1080/19331681.2020.1805085>
- Papakyriakopoulos, O., Hegelich, S., Shahrezaye, M., & Serrano, J.C.M. (2018). Social media and microtargeting: Political data processing and the consequences for Germany. *Big Data and Society*, 5(2), 1-15. <https://doi.org/10.1177/2053951718811844>
- Parratt-Fernández, S., Mayoral-Sánchez, J., & Mera-Fernández, M. (2021). The application of artificial intelligence to journalism: An analysis of academic production. *Profesional de la Información*, (pp. 30-30). <https://doi.org/10.3145/epi.2021.may.17>
- Piñeiro-Naval, V., & Morais, R. (2019). Study of the academic production on communication in Spain and Latin America. [Estudio de la producción académica sobre comunicación en España e Hispanoamérica]. *Comunicar*, 61, 113-123. <https://doi.org/10.3916/C61-2019-10>
- Powers, E. (2017). My news feed is filtered? Awareness of news personalization among college students. *Digital Journalism*, 5(10), 1315-1335. <https://doi.org/10.1080/21670811.2017.1286943>
- Puschmann, C. (2019). Beyond the bubble: Assessing the diversity of political search results. *Digital Journalism*, 7(6), 824-843. <https://doi.org/10.1080/21670811.2018.1539626>
- Santini, R.M., Agostini, L., Barros, C.E., Carvalho, D., De-Rezende, R.C., Salles, D.G., Seto, K., Terra, C., & Tucci, G. (2018). Software power as soft power: A literature review on computational propaganda effects in public opinion and political process. *Partecipazione e Conflitto*, 11, 332-360. <https://doi.org/10.1285/i20356609v11i2p332>
- Schapsal, A.K., & Porlezza, C. (2020). Assistance or resistance? Evaluating the intersection of automated journalism and journalistic role conceptions. *Media and Communication*, 8(3), 16-26. <https://doi.org/10.17645/mac.v8i3.3054>
- Schjøtt-Hansen, A., & Hartley, J.M. (2021). Designing what's news: An ethnography of a personalization algorithm and the data-driven (re)assembling of the news. *Digital Journalism*. <https://doi.org/10.1080/21670811.2021.1988861>
- Seaver, N. (2018). Captivating algorithms: Recommender systems as traps. *Journal of Material Culture*, 24(4), 421-436. <https://doi.org/10.1177/1359183518820366>
- Sehl, A., Cornia, A., & Nielsen, R.K. (2021). How do funding models and organizational legacy shape news organizations' social media strategies? A comparison of public service and private sector news media in six countries. *Digital Journalism*. <https://doi.org/10.1080/21670811.2021.1968920>
- Shahnazi, A.F., & Affi, T.F. (2017). Strategies for literature reviews. In M. Allen (Ed.), *The SAGE Encyclopedia of Communication Research Methods*. <https://doi.org/10.4135/9781483381411>
- Shmargad, Y., & Klar, S. (2020). Sorting the news: how ranking by popularity polarizes our politics. *Political Communication*, 37(3), 423-446. <https://doi.org/10.1080/10584609.2020.1713267>
- Slaek Brlek, S., Smrke, J., & Vobi, I. (2017). Engineering technologies for journalism in the digital age: A case study. *Digital Journalism*, 5(8), 1025-1043. <https://doi.org/10.1080/21670811.2017.1338526>
- Tandoc, E.C., Yao, L.J., & Wu, S. (2020). Man vs. machine? The impact of algorithm authorship on news credibility. *Digital Journalism*, 8(4), 548-562. <https://doi.org/10.1080/21670811.2020.1762102>
- Thorson, K., Cotter, K., Medeiros, M., & Pak, C. (2021). Algorithmic inference, political interest, and exposure to news and politics on Facebook. *Information Communication and Society*, 24(2), 183-200. <https://doi.org/10.1080/1369118X.2019.1642934>
- Thurman, N. (2018). Social media, surveillance, and news work: On the apps promising journalists a 'crystal ball. *Digital Journalism*, 6(1), 76-97. <https://doi.org/10.1080/21670811.2017.1345318>
- Thurman, N., Dörr, K., & Kunert, J. (2017). When reporters get hands-on with robo-writing: Professionals consider automated journalism's capabilities and consequences. *Digital Journalism*, 5(10), 1240-1259. <https://doi.org/10.1080/21670811.2017.1289819>
- Thurman, N., Lewis, S.C., & Kunert, J. (2019). Algorithms, automation, and news. *Digital Journalism*, 7(8), 980-992. <https://doi.org/10.1080/21670811.2019.1685395>
- Tong, J., & Zuo, L. (2021). The inapplicability of objectivity: Understanding the work of data journalism. *Journalism Practice*, 15(2), 153-169. <https://doi.org/10.1080/17512786.2019.1698974>
- Turner-Lee, N. (2018). Detecting racial bias in algorithms and machine learning. *Journal of Information, Communication and Ethics in Society*, 16(3), 252-260. <https://doi.org/10.1108/JICES-06-2018-0056>
- Vállez, M., & Codina, L. (2018). Periodismo computacional: evolución, casos y herramientas. *Profesional de la Información*, 27(4), 759-768. <https://doi.org/10.3145/epi.2018.jul.05>
- Van-Dijck, J. (2020). Governing digital societies: Private platforms, public values. *Computer Law and Security Review*, 36, 105377-105377. <https://doi.org/10.1016/j.clsr.2019.105377>
- Van-Dijck, J., Poell, T., & De-Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford University Press. <https://doi.org/10.1093/oso/9780190889760.001.0001>
- Waddell, T.F. (2018). A robot wrote this? How perceived machine authorship affects news credibility. *Digital Journalism*, 6(2), 236-255. <https://doi.org/10.1080/21670811.2017.1384319>
- Weber, M.S., & Kosterich, A. (2018). Coding the news: The role of computer code in filtering and distributing news. *Digital Journalism*, 6(3), 310-329. <https://doi.org/10.1080/21670811.2017.1366865>
- Wölker, A., & Powell, T.E. (2021). Algorithms in the newsroom? News readers' perceived credibility and selection of automated journalism. *Journalism*, 22(1), 86-103. <https://doi.org/10.1177/1464884918757072>

- Wu, S., Tandoc, E.C., & Salmon, C.T. (2019). Journalism reconfigured: Assessing human-machine relations and the autonomous power of automation in news production. *Journalism Studies*, 20(10), 1440-1457.
<https://doi.org/10.1080/1461670X.2018.1521299>
- Yarchi, M., Baden, C., & Kligler-Vilenchik, N. (2020). Political polarization on the digital sphere: A cross-platform, over-time analysis of interactional, positional, and affective polarization on social media. *Political Communication*, 38, 98-139.
<https://doi.org/10.1080/10584609.2020.1785067>
- Zerback, T., Töpfl, F., & Knöpfle, M. (2021). The disconcerting potential of online disinformation: Persuasive effects of astroturfing comments and three strategies for inoculation against them. *New Media and Society*, 23(5), 1080-1098.
<https://doi.org/10.1177/1461444820908530>
- Ziewitz, M. (2017). A not quite random walk: Experimenting with the ethnomethods of the algorithm. *Big Data and Society*, 4(2).
<https://doi.org/10.1177/2053951717738105>



www.bubuskiski.es



 www.youtube.com/c/CanalBubuskiski

 www.facebook.com/Bubuskiski

 www.twitter.com/bubuskiski