Original Research Article

Algorithmic Journalism: Navigating Societal Challenges and Promoting Public Interest Accountability

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Abstract: News algorithms are being increasingly incorporated into news production process including newsgathering, production and dissemination with an aim to automate journalistic tasks. To this end, this paper examines the societal challenges that limits the adoption of algorithms. Existing literature have discussed ethical issue related to legal accountability of algorithms in the event of producing stories with inaccurate data and potential solution to release algorithm-related information to public in hope of achieving accountability. In doing so, studies have indicated the importance to understand how audiences may perceive on algorithm-based news production. Regarding potential replacement of journalists with algorithms, scholars have found that due to limited access to structured data, algorithms are still far from replacing journalists. In addition, researchers have highlighted that to avoid existing ethical issues of biases and discriminations from being embedded into algorithms, it is crucial to confront and rectify the hierarchical logic that serves as the root cause of discrimination prior to the development of algorithms. In terms of public interest value, studies have touched on the bad influence of newsroom metrics on news coverage and quality due to editorial news selection process being oriented towards audience preferences over publishing stories with public interest value. Traditionally, public service value is also challenged due to excessive dependence of journalists on reliable official sources with economic or political authority for news leads. This creates patterns of asymmetry in service to public, leading to marginalization of social groups. However, this issue has been somewhat overlooked and with the introduction of news algorithms, it could be the right moment to explore the capacity of algorithm-based news to serve the public interest of diverse social groups.

Keywords: News algorithms; Public interest; Societal challenges; Accountability

1. Introduction

In this modern age of technology, algorithms and automation have become inseparable facets of contemporary life. News that we read and watch every day are increasingly suggested and filtered by varying degrees of data-driven algorithms, yet the knowledge of how they are designed or how they operate is often not fully understood. In general, algorithms adhere to a predetermined sequence of steps or guidelines to address a problem (Latzer et al., 2016). A fundamental concern of algorithms is to determine what information processes can be efficiently automated. Automation, therefore, can be defined as "a device or system that accomplishes (partially or fully) a function that was previously, or conceivably could be, carried out (partially or fully) by a human operator." in accordance to (Parasuraman et al., 2000). The type of work algorithms can do, however, is not limited to just solving basic mathematical equations, as one might think in the past. Algorithms nowadays, can also be used to make judging decisions based on data provided including prioritizing, classifying, associating, and filtering, courtesy of rapid development of machine-learning techniques that are capable of learning from past experience or observations (Diakopoulos, 2019).

Because of this, the use of machine-learning algorithms in a profession that involve information intensive

tasks like journalism or news media has been rapidly accelerating, leading one researcher to conclude "Algorithms today influence, to some extent, nearly every aspect of journalism, from the initial stages of news production to latter stages of news consumption" (Zamith, 2019). In data mining stage of news production, for example, some algorithms were being used to monitor streams of real-time data and alert journalists of potentially newsworthy leads based on the pre-set rules (Shearer et al., 2014) or statistical anomaly detection (Magnusson et al., 2016). On the other hand, some algorithms were being used to write automated news to attract audiences in sports and financial earnings (Sirén-Heikel et al., 2019, Wölker and Powell, 2018), and election reporting (Moses, 2017) by converting structured data into texts guided by a predefined set of principles. Similarly, algorithms were also being used to disseminate personalized news content based on users' past selections as well as their friends' consumption through social media networks (Fletcher and Nielsen, 2019, Thurman et al., 2019).

However, aforementioned technical advancements have raised concerns about how algorithms align with regards to the societal function of journalism as a promoter of public knowledge.

To explore this matter, a narrative literature review was conducted for peer-reviewed articles on Google Scholar using the following search terms: algorithms in journalism and automation in journalism. The results obtained using these search terms showed that ethical and economical challenges upon adoption of algorithms was the emergent theme. After an initial scan to determine the main theme of 'ethical and economic challenges', the selected publications were further classified based on thematic analysis to answer the following research questions:

RQ1: How will algorithms be held accountable in event of inaccuracies in published data?

RQ2: How does the role of journalists change in newsrooms with an introduction of algorithms?

RQ3: How does algorithms challenge professional ideal of objectivity?

RQ4: How does algorithms challenge journalism's public service values?

It is impossible to include all existing studies published on this topic, thus, this paper discusses most of the important ones. Despite the inevitable omissions of articles, the goal is to provide readers with a general idea of major research areas in algorithmic journalism, their achievements and current challenges, and recommendations for future research.

2. Accountability of Algorithms

As news production processes are increasingly automated by data-driven algorithms, the question of who is responsible should the published data contain some errors becomes important since at a current state, no ethics exist for algorithms. Stray (2019) emphasized that the use of algorithms in investigative journalism have, so far, been modest. One of the main challenges is the fact that existing algorithms are unlikely to be completely free of errors due to the ambiguous nature of the available data. Therefore, results generated from algorithms cannot be directly published since an inaccurate result might harm someone's reputation or even lead to a libel lawsuit in the event of inaccurately identifying someone to be involved in a crime. Having said that, it is crucial to perform a human checking before algorithmic results are published, especially in investigative journalism cases by sacrificing computational benefits of scale and speed provided by algorithms.

Dörr and Hollnbuchner (2017) provided a framework for recognizing and deliberating ethical concerns using Pürer's (1992) multi-layer model of responsibility (input, throughput and output) and journalism spheres (organizational, professional and social) by Weischenberg et al. (2006) on the basis of automated writing process. The authors pointed out that media organizations should assess the reliability and accuracy of data sources to

avoid publishing reports based on false data, as discussed by Stray (2019). They also highlighted that media organizations also need to consider transparency of news production process such as data source disclosure as well as legal accountability of algorithms. The authors proposed that their framework could serve as a foundation for future studies aimed at establishing ethical guidelines at various levels—organizational, individual/professional, and social/audience—for the practice of algorithmic journalism.

Following Dörr and Hollnbuchner's (2017) study, Diakopoulos and Koliska (2017) sought to align the growing adoption of algorithms in news production with a commitment to transparency as a means to foster accountability. The authors presented a focus group study that undertake 50 participants originating from both academia and the news media to clarify factors that can be disclosed. Results indicate that the information related to algorithms can be revealed across four crucial areas: data, model, inference, and interface. Furthermore, their findings emphasize the significant role of humans in these systems, along with the obstacles to achieving algorithmic transparency. These include organizational disincentives and concerns about overwhelming users with excessive information about how algorithms operate. The authors believe that in order to enable transparency for algorithms, perspectives of multiple stakeholders need to be considered, especially that of news consumers.

Based on the previous discussion, perception of audience on algorithm-assisted news production process is essential not only to develop ethics for algorithms but also to enable transparency as a path to achieve accountability. In view of this, Waddell (2018) explored the effect of machine authorship on perceptions of news credibility and discovered that news articles presumed to be authored by algorithms are perceived as less credible than those explicitly attributed to journalists. The authors concluded that this is associated with the perception of audience on news writing as "a human's job" and this perception is likely to continue until news readers understand the function of algorithms in the production of news. Another study on audience's judgement on machine authorship was done by Liu and Wei (2019) discovered that machine-generated articles were perceived as more objective and less emotionally involved compared to human-written news, regardless of the media organization or the depth of news interpretation. Similar study on evaluations of content credibility produced by automated writing carried out by Graefe et al. (2018) agrees with the outcome. On the contrary, Wölker and Powell (2018) examined European news consumers' perceptions of automated, human, and hybrid writing, where automated content is complemented by journalistic input. Their findings suggested that readers perceive news credibility similarly across automated, human, and hybrid writing, except in the case of sports articles, where automated content is notably considered more credible than that written by human journalists. The authors also examined whether credibility judgements have an impact on the decision of audience to choose automated contents and contrary to the expectations, credibility judgements do not influence selectivity of automated articles. However, since the study is limited to sports and finance topics, future research should focus on less 'routine' topics to supplement their findings. This aligns with Jung et al.'s (2017) findings, demonstrating that audiences were unable to distinguish between articles written by algorithms and those authored by journalists. However, the study also confirmed a negative perception of journalists' credibility among the public in Korea. Their results indicated that articles identified as algorithmically written received higher ratings regardless of the actual author.

Similar to the perception of audience on automated writing, other researchers explored approval of audience on algorithm-assisted news personalisation or recommendation. Fletcher and Nielsen (2019) studied how users perceive different types of news selection based on editorial suggestions and algorithmic recommendations on

social media. The analysis involves both focus groups and survey data from three European countries along with the United States. Their research indicated that younger generations tend to express greater approval of algorithmic selection, which correlates with their heightened awareness and understanding of algorithms. In addition, audiences with a strong interest in 'soft' news topics are more inclined to accept suggestions from algorithms adopted from their friends have chosen. Based on the results, the authors argued that "the way in which most people navigate news on social media is thus based on a 'generalized scepticism' where people question all kinds of selection, including those they feel they have a relatively good understanding of (editorial selection by news organisations) and those that many of them have a much more limited understanding of (algorithmic selection by platform companies)(p.4)" Similar conclusion of the fact that the audience collectively prefer algorithm news selection guided by their past behaviour to editorial selection was drawn from the study of Thurman et al. (2019).

Recently, an intimate form of news recommendation service, chatbots that uses private social media platforms to deliver news has been introduced. While chatbots, categorized as Conversational User-Interfaces (CUI), have found widespread application in customer service, their utilization as a platform for disseminating news has been relatively restricted. The implementation of chatbots for distributing news has been partly influenced by the shift in social media usage from public platforms, such as Facebook to relatively private channels, such as WhatsApp. Ford and Hutchinson (2019) conducted a case study examining the Australian Broadcasting Corporation (ABC)'s chatbot, exploring the impact of social media for news delivery and automation on the evolving relationships between ABC and its audience. The chatbot was designed to communicate in a way that reflects particular journalistic personas. As a result, the findings showed that a section of the audience who use the chatbot appreciates the friendly experience that contrasts favourably with their past experience with news delivery from journalists. From the perspective of journalists, it provides a mean to reach an audience that had not previously engaged with news, thus potentially bringing new audiences which fulfils the universality goals of the media organizations. Despite these advantages of chatbots, the authors also highlighted ethical concerns arising from reliance on third-party social media platforms for message delivery. These include issues of data ownership, user privacy, and perceptions among audiences regarding the trustworthiness of messaging service providers.

Jones and Jones (2019) conducted a qualitative study on BBC's newsbots, revealing that BBC has deployed nearly twelve newsbots across its own website and various third-party platforms such as Twitter, Facebook, and Telegram. The authors also identified BBC's motivation for experimenting with bots: to connect and engage with underserved audiences, particularly the youth. However, Jones and Jones' pointed out that at the current state, empirical evidence about whether such newsbots will be successful is still very limited.

Having witnessed the current state of increased integration of algorithms into news production process of journalism and accompanying ethical issues, Lewis et al. (2019) pointed out that current research efforts on algorithmic journalism are based on the theoretical assumption of considering humans as communicators (message sources) and machines as mediators (message channels) which fail to provide the theoretical way of addressing the changing landscape of technology and its impact on communication The authors suggested to use Human-Machine Communication (HMC) conceptual framework that treats technology as communicator instead of mediator which opens up opportunities to explore varying degrees of machine incorporation into formally human role of journalism.

Following up on the study of Lewis et al. (2019), Guzman (2019) pointed out the importance of audience perceptions on automation since the incorporation of machines into what was previously a human-to-human interaction between journalists and consumers raises the questions regarding how consumers will perceive the automated contents that they receive which in turn, will affect the audience demand. He also emphasizes that the evaluations of audience perception on automation should go beyond assessing the quality of automated content and directly examine how consumers understand technology as a communicator instead of just a tool to assist journalists with news production.

3. Role of Journalists in Contemporary Journalism

Miroshnichenko (2018) conducted a review of the current landscape of algorithmic journalism, particularly exploring the potential future role of robots replacing journalists. The study emphasized the efficiency advantages of machines over humans in tasks such as data mining, topic selection, comment moderation, and automated writing. The authors argued that media organizations will eventually replace human journalists with robots due to promising economic benefits that robots can bring thorough production of many more articles that can attract more audience. He also believed that the quality of a good article will be outmatched by quantity of articles that a machine can produce when it comes to attracting more readers. He demonstrated his argument with an example of Wordsmith, a powerful news-writing algorithm developed by Automated Insights, wrote 4400 corporate earning reports per quarter for Associated Press, thus attracting more subscribers compared to human journalists, who could only produce 300 recaps per quarter. The limitation of Miroschnichenko's study is that he did not take challenges including organizational factors such as journalists' attitudes towards adoption of algorithms and aforementioned ethical issues into account.

On the contrary, Linden (2017) argued that despite being more efficient than journalists in every news production department, adoption of algorithms faces challenges including access to structured data, and intraorganizational tension between existing journalists and newly introduced computer scientists in the workplace. As of now, he highlighted that the optimistic dream of having public access to all data is limited due to the lack of incentives from public bodies such as municipalities to computerize printed records. On the other hand, the author also discussed potential organizational tensions that may arise as journalists work closely with newly employed computer scientists to learn the way to critically investigate algorithm decision systems. In agreement with Linden's (2017) study, Wu et al. (2019) contended that social structures impact journalistic practices, but the adoption of automation by media organizations and journalists' decisions will gradually reshape these structures. This evolution depends on the skills acquired and the attitudes towards embracing automation versus maintaining traditional practices within the field. Milosavljević and Vobič (2019) similarly emphasized the importance of journalists' relevance. Their research highlighted that news editors across Europe perceive a shifting professional ideology in journalism due to the integration of automation in newsroom evolution. The editors noted the ways in which automation poses challenges to journalism's fundamental principles (such as public service, autonomy, and objectivity), while also acknowledging that human journalists and computer scientists remain essential in developing automated processes. The authors introduce the concept of a 'human-still-in-the-loop' perspective to emphasize that journalism is undergoing a gradual transformation. This perspective suggests that new technologies will not simply be introduced to replace existing methods, but will instead be integrated progressively into the current news production process.

The issue of getting access to structured data is also discussed by Sirén-Heikel et al. (2019), who interviewed

media representatives to explore the methods employed by media organizations envision the capabilities of news algorithms in automated writing. The authors noted that algorithms are seen not only as enhancing efficiency, thereby speeding up output, but also as aiding in reallocating resources to enhance the quality of journalism. However, these perceived benefits are constrained by challenges such as access to structured data, algorithm quality, and insufficient expertise in securely managing large datasets without compromising privacy. The difficulty in obtaining access to structured data beyond finance and sports topics has also been reported by Fanta (2017) who carried out investigations across Europe and the US.

4. Professional Ideal of Objectivity

Carlson (2019) discussed an interesting notion of "mechanical objectivity" which is the belief that machines are capable of producing outputs that overcomes the limits of human subjectivity. In his discussion, he explores what the concept of mechanical objectivity can provide to algorithmic journalism studies and argues that despite the belief that algorithms are neutral and free of human biases, pre-existing societal biases are embedded inside these algorithms. As a result, algorithms function as a significant participant in news production, prompting important inquiries into biases, judgments, and the impact of technology on these matters.

Regarding the algorithms being an epistemic actor within news production, the need to address existing discrimination injustices in journalism before designing news algorithms was pointed out by Hoffmann (2019). She argued that direct confrontation of the very hierarchical logic that produces discrimination in the first place should be made so that the underlying logic that leads to unjust hierarchies of advantaged and disadvantaged subjects would not be embedded inside algorithms that are yet to be designed.

Implementations of algorithms in news dissemination process has led to the rise of automated news recommenders that have the ability to serve individual consumers efficiently by delivering personalized news content. To gain some insight into how news organizations design and implement personalized news recommendation service, Bodó (2019) conducted interviews with professionals from media companies in Europe and reported that European news media utilizes news personalization as a mean to increase long-term audience loyalty by selling quality news rather than adhering to what Bodó refers to as "platform logic of personalization" which relies on social media platforms to deliver news personalization in view of enhancing engagement and selling audiences to advertisers. In line with Bodó's study, Myllylahti (2018) questions the strategy of New Zealand news companies to distribute news on social media such as Facebook since the audience traffic and social shares hardly improves their renveues. Based on her findings, Myllylahti argues that it is about time for news organizations to perhaps abandon platofrm-based news personalization service and rethink their news distribution strategies.

In order to compare effetiveness of different social media platforms in seeking audience attention, Myllylahti (2020) introduced a conceptual framework aimed at examining revenue models in digital journalism that focus on capturing user attention on platforms. Her framework suggests the necessity of exploring where and how news content attracts attention, the methods used for its collection, analysis, and measurement, as well as who monetizes it and through what means. She asserts that her framework provides valuable insights into evolving patterns of news consumption, opportunities for monetizing news content, shifts in power dynamics between platforms and media organizations, and risks associated with platform-based news distribution.

Helberger (2019) expressed concern about how news recommenders might affect the democratic role of journalism, questioning whether an environment where each user receives tailored news will still foster a public

forum where diverse ideas and opinions can freely converge. Helberger created a democratic framework to investigate the various societal roles that news recommenders might fulfill. The first type of news recommender, she argues, is designed based on liberal tradition which prioritizes the users' personal preferences to suggest news. On the other hand, participatory news recommenders as she suggests, focuses on delivering information that reflects the interests of society in order to promote citizen's involvement rather than emphasizing on fulfilling individual's news preferences. Deliberative news recommenders, according to her, targets to promote public discourse by introducing various perspectives on news articles. Last type of news recommenders, she discusses, is critical recommender which aims to deliver less popular contents and marginalized voices that are often left unheard. Helberger's article illuminated the concept of news personalization by providing a conceptual framework that can be used to conduct further research on news recommenders and their influence on democracy. She also emphasized that like most technologies, recommenders are neutral tools whose impact on democracy depends largely on how the media employs them.

Similar to news dissemination process, automated news writing process is also prone to biases in terms of the content and language used in the text. Automated production of news text can be achieved via rule-based or machine learning-based algorithms. Methods on how biases inside these systems can be detected was presented by Leppänen et al. (2020). For a rule-based system, Leppänen et al. suggested that it might be possible to examine the logic and rules embedded inside the algorithms and identify if any of them are evidently biased. For systems that are much sophisticated for manual investigations, the authors recommended to use a practical approach based on input variation in which a system's inputs are varied and its results are inspected for biases. When discussing machine-learning based systems, the authors revisited language models, which are machine-learning models designed to assess the likelihood of a sentence based on the training data they were exposed to. Leppänen et al. (2020) hypothesized that if language models are trained using an extensive dataset of news articles written by algorithms, they would learn and preserve all the existing biases in such algorithms and resulting language models could be used to interrogate biases in the underlying algorithms. The authors argue that the methods mentioned above should be applied to real-world systems to establish optimal practices for conducting audits and identifying the sources of detected biases.

5. Public Interest Value

Moyo et al. (2019) investigated how newsroom metrics are influencing editorial decision-making process on news production by performing semi-structured and unstructured interviews with online editors and journalists working in newsrooms across African countries. From the results, Moyo et al. found that editors focus on producing more content aligned with audience interest to attract more readers in response to rising economic pressures rather than publishing stories with public interest value. The authors argued that the desire to meet the needs and expectations of the audience informed by the metrics has been leading to the failure of journalism's traditional role of setting the agenda and leading the public discourse.

Recognizing the significant influence of audience metrics on news quality, Fürst (2020) conducted a review indicating that these metrics have a detrimental effect on the quality of news reporting. As part of her study, Fürst examines how newsroom metrics impact news quality through aspects of the journalistic production process such as the volume, practices, and rhythms of news production, as well as the selection and placement of topics. In the former process, she observed that newsrooms aim to produce many 'quick hit' stories as a result of putting more emphaiss on audience traffic which leads to poor news coverage. In the latter process, she found

that journalists increasingly choose topics depending on audience preferences, informed by metrics regardless of journalistic pertinence and newsworthiness which leaves some topics of public interest out of the coverage and clearly reduces journalistic editorial values. Similarly to Fürst and Moyo et al., Myllylahti (2017) questions the usefulness of metrics in newsrooms given that there is no evidence that the use of metrics leads to an increase in media organizations' revenue based on his review of literature. He then suggested that metrics should be considered as managerial tools rather than journalistic ones for the sake of protecting core journalistic values and integrity.

Apart from the discussed challenges related to algorithms, journalism's public interest value is also traditionally challenged as a result of selectively choosing the news sources but it is less explored. Rupar (2017) introduced the concept of inclusive journalism which can be defined, according to Rupar, "as a set of normative discourses, editorial policies and reporting practices that have arisen and have been developed to provide a diversity of voices in media domain (p.419)" Rupar highlighted that the concept of inclusive journalism becomes relevant because journalists often overly rely on obtaining news leads from trusted official sources like governments, trade unions, and professional associations. These authoritative official sources, who wield economic or political power, exert influence over the content of news articles (Shoemaker and Reese, 2013). This influence can restrict critical discourse on public issues and marginalize certain social groups, thereby impacting democratic societies. Furthermore, she also emphasized how social media may provide a pathway to promote inclusive journalism due to the access to a vast number of sources, but verification efforts of these sources are still very limited. With an introduction of algorithms, it would be interesting to explore whether algorithms may determine, preserve or amplify marginalization of social groups.

6. Conclusion

To conclude, this paper provides a comprehensive review of scholarly articles related to algorithmic journalism with an emphasis on societal challenges that algorithms pose in journalism including accountability, perception of audience, replacing journalists, professional ideal of objectivity and public service values.

In summary, existing literature have discussed ethical issue regarding legal accountability of algorithms when publishing stories with inaccurate data and attempts to make algorithm-related information transparent for achieving accountability. In doing so, studies have pointed out the importance of audience perception on algorithm-assisted news production process towards understanding the extent of data transparency needed to supply news consumers. In addition, scholars have also investigated threats on jobs of journalists imposed by algorithms given that they are much more efficient than journalist and potential to bring economic benefits. Furthermore, researchers have highlighted the need to resolve existing issues of biases and discriminations that challenges the journalism ethics of objectivity before algorithms can be designed. This is to avoid such issues being embedded inside newly developed algorithms. Moreover, studies have touched on the negative influence of newsroom metrics on judgements of journalistic newsworthiness as a result of choosing topics depending on audience preferences to attract more readers rather than publishing stories with public interest value.

On the other hand, excessive dependence of journalists on reliable official sources with economic or political authority for news leads creates patterns of asymmetry in service to public, leading to marginalization of social groups. However, this issue has been somewhat overlooked and with the introduction of news algorithms, it could be the right moment to explore the capacity of algorithm-based news to serve the public interest of diverse social groups.

Declarations

There is no conflict of interest.

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