

Amaya Noain-Sánchez

<https://orcid.org/0000-0002-2845-3285>

amaya.noain@urjc.es

Universidad Rey Juan Carlos

Submitted

March 22nd, 2021

Approved

February 12th, 2022

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Communication & Society

ISSN 0214-0039

E ISSN 2386-7876

doi: 10.15581/003.35.3.105-121

www.communication-society.com

2022 – Vol. 35(3)

pp. 105-121

How to cite this article:

Noain-Sánchez, A. (2022).

Addressing the Impact of Artificial

Intelligence on Journalism: the

perception of experts, journalists

and academics. *Communication &*

Society, 35(3), 105-121.

Addressing the Impact of Artificial Intelligence on Journalism: the perception of experts, journalists and academics

Abstract

Over the last decade, Artificial Intelligence (AI) has become gradually more prevalent in mass media and news agency newsrooms. This growing tendency has prompted intense debate about the negative impact on journalism, particularly on quality standards and ethical principles. Taking an explorative approach, this study aims to analyse the application of AI in newsrooms, focusing on the impact on news-making processes, media routines and profiles, highlighting the benefits and shortcomings, and finally, analysing the rise of ethical dilemmas. For this purpose, 15 in-depth interviews were conducted in two rounds, in 2019 and 2021, with a sample of journalists and other media professionals, academics, experts on the media industry, and providers of technology leading the work on AI. The international sample includes interviewees from the United States, the United Kingdom, Germany and Spain. The interviewees agree that AI will enhance journalists' capabilities by saving time, augmenting the efficiency of the news-making processes and, therefore, increasing mass media industry productivity. However, a change of mind-set in the media environment is needed, and training on the use of these tools must be a priority given the lack of knowledge observed. Finally, the emergence of ethical issues underlines the need for continuous control and supervision of the processes undertaken by AI.

Keywords

Journalism, artificial intelligence, automated journalism, algorithmic journalism, robot journalism, computational journalism, augmented journalism.

1. Introduction

Artificial intelligence (hereinafter, AI) has expanded rapidly in society, and it is gradually gaining ground in journalism (Newman, 2020). AI provides tools for the codification of tasks and routines in algorithms, creating outputs similar to those produced by humans (Túñez-López, Toural-Bran & Cacheiro-Requeijo, 2018).

Therefore, the adoption of AI provides a wide range of benefits to mass media and news agencies, whilst at the same time introducing changes on at least three levels: the role of journalists in the production of texts, their substitution in carrying out certain activities, and interaction with the audience (Gomez-Diago, 2022).

One of the most promising fields refers to the automatic production of content. This is already possible in areas based on structured data, such as sports results, financial earnings

and weather forecasts: Algorithms can convert data into informative and narrative texts, leading to the production of thousands of stories with little or no human intervention other than the initial programming (Carlson, 2015, Graefe, 2016).

The need to increase the production of news and engage the audience is behind the adoption of these tools (Papadimitriou, 2016; Graefe, 2016; DeVito, 2017). AI tools augment the capabilities of journalists, thus facilitating specific activities of the news production process, and improving their work to standards not achieved before (Tejedor & Vila, 2021). Among other activities, AI can facilitate the detection of informative trends (Steiner, 2014); the collection of information (Diakopoulos 2019), the development of news-recommendation systems (Helberger, 2019, Túnnez-López, Fieiras-Ceide & Vaz-Álvarez, 2021); the verification of disinformation (Flores Vivar, 2019 Manfredi-Sánchez & Ufarte-Ruiz, 2020); the automatic translation of texts; and the development of investigative journalism (Papadimitriou, 2016; Newman, 2018; Newman, 2020). AI can also make journalists' work more efficient, freeing them up from some repetitive or routine tasks (Diakopoulos, 2019). These are examples, too, of the kind of 'datafication' process affecting society as a whole (Loosen, 2018).

At the same time, however, this technology gives rise to a lot of questions and debate about the quality of the outputs created by AI (Manfredi-Sánchez & Ufarte-Ruiz, 2020), and the likelihood of these tools eroding ethical principles and the core values of journalism (Ufarte-Ruiz, Calvo-Rubio & Murcia-Verdú, 2021). Therefore, despite the many advantages AI provides to journalism, the phenomenon should be approached "through the balance between the business perspective (profitability) and the human perspective (social and perceptible)" (Segarra-Saavedra, Cristòfol & Martínez-Sala, 2019). Given this framework, the article aims to contribute to the discussion around the adoption of AI in mass media newsrooms, identifying different points of view, attitudes towards the technology and perspectives regarding its application.

2. Conceptual framework

Although the notion of AI is attributed directly to Alan Turing (Salazar, 2018), the term was coined by John McCarthy, Marvin Minsky, Claude Shannon and Nathan Rochester in the 50's. At that time, AI was defined as the science of making a machine behave "in ways that would be called intelligent if a human were so behaving" (Russell & Norvig 2019). According to Beckett, AI encompasses a collection of ideas, technologies, and techniques related to the ability of computer systems or software to perform tasks that normally require human intelligence (2019). To fulfil those tasks, these cognitive technologies make use of two basic attributes: a) autonomy, and b) the capacity to learn from experience. Since it appears to mimic human "intelligence," the adoption of AI provokes distrust and hostility. And as a consequence of the openness and ambiguity of the term, its introduction gives rise to more doubts than certainties. Furthermore, the umbrella of AI covers such subfields as machine learning, supervised learning, unsupervised learning, natural language generation (NLG) or natural language processing (NLP). All of them, though referred to as "AI," draw on different attributes and show different capacities.

The complexity associated with the conceptual definition of AI is reflected in the variety of terms used to address the phenomenon in journalism. For instance, when it comes to content generation, where content is produced automatically by an algorithm, it is usually referred as "automated journalism" (Caswell & Dörr, 2018; Graefe, 2016; Lindén, 2017; Napoli, 2012) or "algorithm journalism" (Dörr, 2016; Diakopoulos, 2014). This is defined as: "the (semi)-automated process of natural language generation by the selection of electronic data from private or public databases (input), the assignment of relevance of pre-selected or non-selected data characteristics, the processing and structuring of the relevant data sets to a semantic structure (throughput), and the publishing of the final text on an online or offline platform with a certain reach (output)" (Dörr, 2016, p. 412). However, we also find other terms

collected by Vázquez and Codina (2018): “robot journalism” (Carlson, 2015; Clerwall, 2014; Montal & Reich, 2017; Thurman, Dörr & Kuhnert, 2017, Oremus, 2015); “augmented journalism” (Marconi & Siegman, 2017); “computational journalism” (Díaz-Campo & Chaparro-Domínguez, 2020; Vázquez & Codina, 2018; Coddington, 2015; Cohen, Hamilton & Turner, 2011; Stavelin, 2014); “machine written journalism” (van Dalen, 2012). The list may be rounded out with: “exo-journalism” (Tejedor & Vila, 2021) or “artificial journalism” (Túñez, Toural & Valdiviezo, 2019). Other scholars compare AI tools to data journalism or data driven-journalism (Parasie & Dagiral, 2012).

In 2009, Latar and Nordfors were among the first to point out the crucial role that AI would play in future newsrooms. However, the frequent use of AI in journalism goes back to 2013, when Associated Press (AP) automated the production of narrative text stories directly from data related to sports and, soon thereafter, for corporate earnings reports, using the technology of Automated Insights (Brandom, 2014, Graefe, 2016, Lichterman, 2017; Lindén, 2017). Therefore, AP was the first news agency “in combating two mega-trends in the business: the relentless increase in news to be covered and the human constraints associated with covering it” (Marconi & Siegman, 2017, p. 1). After AP, news agencies such as France Press and Reuters began to increase their news production thanks to algorithms (Túñez-López, Feiras-Ceide & Vaz-Álvarez, 2021) and media such as the *Los Angeles Times* launched the first bot (Flores Vivar, 2019). Since then, a myriad of examples from news agencies, to public and private media verifies that AI tools can work at various levels and phases of the production process, providing media companies with competitive advantages.

3. Current state of play

There is fast-growing body of academic literature on AI and journalism. Fanta’s contribution on automated journalism in new agencies based in Europe (2017) and the report by Marconi and Siegman on the use of AI at the Associated Press (AP) (2017) illustrate the first examples of the inclusion of these tools in content production. In their report, Marconi and Siegman address the rise of new profiles such as the ‘reporter +AI’ and the ‘desk editor +AI,’ among other transformations that ‘are not drastic, but are important to keep in mind when implementing AI in a newsroom’ (2017, p. 4). Regarding the mass media, the first lists of newsrooms adopting automated methods for content production dates back to 2016 (Dörr, 2016; Graefe, 2016). Dörr (2016) conducted semi-structured interviews with Natural Language Generation (NLG) service providers, analysing the benefits of this technology in newsrooms. Karlsen & Stavelin use the case study to approach the adoption of AI in the six major Norwegian newsrooms. After conducting in-depth interviews in order to compare traditional journalism to computational journalism, they found that despite significant variation across the technical skills and tools used, the objectives and values are similar (2014). Lindén (2017) and Salazar (2018) combined case studies of journalistic initiatives and interviews with experts. Whereas Salazar focuses on the ethical perspective, Lindén identifies the viewpoints of professionals and mass media when confronted with automated content generation, outlining the benefits of a technology that allows journalists steer away from routine tasks. On the other hand, van Dalen (2012) analysed how journalists interact with a network of information websites reporting sports topics entirely written by algorithms. Thurman, Dörr and Kuhnert (2017) interviewed professionals from the CNN, BBC and Thomson Reuters to collect their opinions on some journalistic articles produced by AI. Similarly, Daewon and Seongcheol analysed journalists’ attitudes towards news automatization (2018). For their part, Túñez, Toural and Cacheiro (2018) surveyed journalism associations to obtain an insight into the professional perception in Spain, highlighting the lack of knowledge about these developments at a professional level.

The research laboratory *Journalism AI*, a think tank at the London School of Economics and Political Science carried out one of the most comprehensive studies on the subject: based

on a survey of the state of application of AI and associated technologies in 71 news organisations, from 32 different countries, the report addresses the importance that AI has acquired in the journalistic sector. Additionally, it underlines some of the challenges observed in the adoption of these tools, such as limited financial resources (27%), lack of knowledge or skills (24%), and cultural resistance (24%), including fear of job losses, changing work habits, and a general hostility to new technology. Besides, the report remarks on the growing inequalities between small and large organisations and the need for a change of mind-set in newsrooms. Moreover, it emphasises the dangers of focusing exclusively on obtaining benefits at the expenses of journalism quality and news diversity, which may be undermined by an excessive and uncontrolled use of algorithms (Beckett, 2020).

As for educational practices, the mass media companies stress the need to train future journalists in the use of AI (Beckett, 2019). In Spain, for example, AI technology is absent from the curricula of journalism degree and master's programs. Thus, commentators have underscored the pressing need to incorporate innovative teaching experiences in journalism, identifying ways to introduce AI in communication studies (Gomez-Diago, 2022; Ufarte-Ruiz, Calvo-Rubio & Murcia-Verdú, 2020; Ufarte-Ruiz, Feiras-Ceide, Túnnez-López, 2020). Although not all processes may be automatized, journalists will have to update their knowledge and technical skills to understand how these tools work (EBU, 2019). In line with this conclusion, researchers from the Tow Center for Digital Journalism have underscored the need for mass-media companies to invest in specialized training for journalists, so that they are able to understand the technology and use it in an appropriate and ethical way (Hansen, Roca-Sales, Keegan & King, 2017). Research into the unequal adoption of these technologies in newsrooms is still scarce (Wu, 2019). However, this unequal adoption may pose a serious challenge, particularly when it comes to the development of small organizations (Beckett, 2019).

Regarding the credibility and objectivity perceived by the audience, Yanfang examines if readers are able to tell the differences between pieces of news written by humans and those written by machines (2019), whereas Möller focuses on the editorial role of algorithms in decision-making and its implications for information diversity and plurality (2018). Thurman, Moeller, Helberger and Trilling evaluate audience perceptions of automated news, coming to the conclusion that users show interest in knowing if the selection was made by a human or a machine (2018).

When it comes to areas of implementation, the Observatory for Innovation in News in the Digital Society (O_{i2}) linked to RTVE and UAB has published three studies about news detection (Ruiz *et al.*, 2019), automatic writing (Ruiz *et al.*, 2020a) and content personalization (Ruiz *et al.*, 2020b). Additionally, AI may facilitate automatic translation and the launch of news-recommendation systems (Helberger, 2019, Túnnez-López, Feiras-Ceide & Vaz-Álvarez, 2021), to analyse data, obtain trends, and automate actions such as changing the format from text to video, and optimize content distribution (Marconi, 2020; Neuman, 2021). Flores-Vivar explores the main developments of bots used to minimize the impact of disinformation (2019). Scholars also focus on the suitability of these tools to cover local information (Lecompte, 2015) and sports (Rojas Torrijos & Toural Bran, 2019), and in carrying out documentation tasks (Segarra-Saavedra, Cristófol & Martínez-Sala, 2019).

Other authors provide a glimpse into the future of journalism: Tejedor-Calvo *et al.* (2020) analyse the possibilities of augmented reality (AR) in journalism. Their study brings together in-depth interviews with experts who analyse the possibilities of augmented reality (AR) in journalism, including its weaknesses and some proposals for new journalistic scenarios. On the other hand, Freixa, Pérez-Montoro and Codina (2021) highlight the interaction and visualization binomial in digital news media as a tool to build audience loyalty and demonstrate the media's commitment to its readers.

Regarding the ethical aspect, Dörr and Hollnbuchner address the implications of algorithm journalism, evaluating it at three different levels (input, throughput and output), and matching them with three spheres of activity: Organizational Sphere, Professional Sphere and Social Sphere. As the authors state, the interdisciplinarity inherent to AI processes turns the ethical approach into a crux “at the intersection of digital media ethics and cyberethics” (Dörr & Hollnbuchner, 2017, p. 408). From an interdisciplinary perspective, the implementation of ethical codes for the use of AI is an unavoidable obligation (Salazar, 2018). Among the ethical implications, the authors underline the need to protect freedom of speech, transparency and accountability, and stress the risks of disinformation and lack of plurality and diversity, above all in news recommendations systems (Helberger, 2019). These systems might show biased information to users, thus reinforcing preconceived ideas by limiting exposure to content diversity (Bodó, 2018; Ignatidou, 2019). Similarly, the OSCE meeting *Freedom of the media and artificial intelligence* highlighted the crucial role governments may play in promoting and guaranteeing pluralism (Haass, 2020). Public mass media are also expected to implement the design of algorithms that respect the core values of journalism by default, thus assuring that they promote content diversity, even if users decide to personalize the selection of content (van den Bulck & Moe, 2017). However, not all users show interest or have the skills required to personalize such contents (Bodó *et al.*, 2019). Finally, ethical issues arise when news selection and personalization comes from user profiling, violating, therefore, their data protection rights (Monzer *et al.*, 2018).

4. Objectives and research questions

The main objective of research is to explore how AI is being adopted in newsrooms, focusing on the impacts of these tools on news production, quality standards, working routines, mass media professional perceptions and ethical principles. To achieve this purpose, we set two specific objectives:

- O1. To collect the perspective of the different groups of people involved in the adoption of AI in journalism.
- O2. To address the outputs observed in the different experiences of implementation.

The study is guided by the following research questions:

- RQ1. How is AI being integrated in newsrooms?
- RQ2. What are the benefits and challenges of this technology?
- RQ3. What are the ethical concerns relating to this technology?
- RQ4. What impact will AI have on the future of journalism? (New profiles, changes in the industry, education and training).

5. Methodology

A literature review on the academic database Scopus was the starting point of research. The results were filtered using as keywords the aforementioned terms related to the intersection of AI and journalism and framing the search within the last ten years. The search was completed with reports elaborated by international research institutions.

Qualitative methods were used through in-depth interviews taking an international approach. Previous studies on the subject matter used this methodology to report cases of AI in journalism in Spain (Túñez-López, Fieiras-Ceide & Vaz-Álvarez, 2021) and from an international perspective (Fanta, 2017; Sandoval-Martín & La-Rosa, 2018).

For the purposes of this research project, 32 invitations were sent, and 20 people answered the invitation. The saturation point is considered to have been reached with 15 interviews, at which point some of the answers began to be reiterative. These 15 in-depth interviews were carried out in two rounds: between October 2019 and February 2020, and between October 2020 and January 2021. Transcription was carried out in February 2021. Two

rounds were undertaken in order to address developments and new outputs not registered during the first interviews.

The selection includes experts and academics, mass media professionals and technology providers from Germany, Spain, the United States and the United Kingdom. The selection aims to cover a wide range of agents involved in the adoption of AI. Particularly, in the group comprised of mass media professionals, interviewees were selected taking into account several application areas: data verification, content curation, detection of toxic comments¹, content generation, personalization, web analytics, news identification, documentation and tools to assist journalists.

Therefore, the sample includes:

1. (JM) Jeremy B. Merrill (USA). Data journalist at *The Washington Post*, *ProPublica*, *The New York Times* and *Quartz*. He uses machine-learning and data analysis for investigative journalism.
2. (AH) Angie Drobnic Holan (USA), editor-in-chief of *PolitiFact*, a fact-checking web that makes use of AI.
3. (CE) Christina Elmer (Germany), Deputy Head of editorial development at *Der Spiegel*. She co-managed the relaunch of the digital platform and established the data journalism department. Additionally, she is Professor for Digital Journalism and Data Journalism at TU Dortmund University and a member of the German Association of Investigative Journalists.
4. (MP) Mattia Peretti (UK), Manager of *JournalismAI*, a research and training project run by Polis, the international journalism think-tank at the LSE with support from the Google News Initiative.
5. (MR) Miguel Rodríguez (UK), Data journalist at Press Association and Urbs Media. He is in charge of the automatization unit RADAR (Reporters and Data and Robots) within Google's Digital News Initiative (DNI).
6. (DC) David Corral (Spain), Director of Innovation at RTVE.
7. (GC) Guillermo Castellanos (Spain), Web Analytics journalist at *El País*.
8. (BM) Bárbara Maregil (Spain), Digital Producer at *El País*. She is in charge of the implementation of automatization and content recommendation tools.
9. (DL) David Llorente (Spain), CEO of the company Narrativa, which sets an industry standard in algorithmic solutions for information content.
10. (PS) Pablo Sanguinetti (Spain/Germany). Journalist and computer programmer. Former teaching fellow at Google News Lab for Portugal and Spain.
11. (IS) Idoia Salazar (Spain). Journalist and co-founder and president of the Observatory of the Social and Ethical Impact of Artificial Intelligence (OdiseIA). Expert contributor to the European Parliament's Artificial Intelligence Observatory (EPAIO).
12. (TC) Tamar Charney (EEUU). Content personalization, content curation and managing editor at *NPR One* (NPR).
13. (VB) Virginia Bazán (Spain). Innovation Projects at RTVE Archive. She carries out research into connecting automatic metadata generation and image recognition tools.
14. (TV) Toni Vilalta (Spain). Product Manager at VSN-Video Stream Networks.
15. (EL) Eugenio López (Spain). Director of the Documentation Unit at Atresmedia.

¹ Defined as the detection of rude, disrespectful, or unreasonable comments in virtual communities, social networks and other sites that are likely to make other users leave a discussion.

6. Results

6.1. Areas of application

According to the interviewees' experiences of implementation, AI is entering the newsrooms to enhance and complement journalists' capabilities, particularly when it comes to content generation:

(MR) *'The automatization unit [of Urbs Media] combines text written by journalists with texts artificially produced from data. Those data come from public databases of the UK Government on economics, sport or weather. It is always oriented to local media.'*

(DL) *'Part of the text generated works as a draft for the journalists. [The technology provided by Narrativa to RTVE enables them to] create some layouts that work as a first version of the texts, so that the journalist can write the piece of news with context.'*

The automated generation of text benefits from a greater capacity of personalization, providing users with contents in line with their previous interests:

(TC) *'NPR created a project called NPR One Algorithm to personalize and localize podcasts on a variety of platforms [...] Algorithms learn about the listeners' preferences and gives them the contents they like. It is a personalization and recommendation algorithm.'*

Additionally, the capacity to analyse large amounts of data, together with the processing of natural language, turn these tools into a technology capable of analysing audiences, identifying topics of interest and verifying data.

(CE) *'AI algorithms can help with the analysis of lots of data for a specific journalistic report as part of an investigation.'*

(DC) *'Inside the newsroom, we began by using an alert system called Datamin. It uses AI to detect contents on social networks that may be of interest [...] such as accidents, attacks or claims from people.'*

(AH) *'There is a program called ClaimBuster [...] It is able to pick the text apart, looking for the kinds of words and phrases that usually express claims and that might be tested. It also skips over irrelevant statements.'*

The AI subfield called 'machine learning' is used to recognize inappropriate content or toxic comments. In this case, algorithms can identify swear words and other offensive comments. This is the case of *Perspective*, a tool already used by the *New York Times* and that is now integrated in the newsroom at *El País*:

(BM) *'It's a deterrent tool. When a user is writing a post and the tool detects something that might be harmful, it alerts the user and indicates that it is possible to edit it in order to avoid those words. If the post is finally sent, another application, Interactora, will detect it, and the post will not be published.'*

When it comes to the documentation area, the automatic metadata applied to the video provides the journalist with the automatic description of scenes, including the recognition of people of interest and objects. In the case of the audio:

(VB) *'The system makes the transcription from audio to text, identifying speakers, the main entities, orthography, and keywords.'*

(TV) *'While searching for content, journalists can demand an automatic sequence, a timeline of the images that are relevant according to their search criteria, and create a timeline with a proposal for editing.'*

6.2. Advantages and disadvantages

From the point of view of the interviewees, AI related tools provide more benefits than drawbacks, particularly in tasks that involve dealing with vast amounts of data:

(JM) [Algorithms] *'Read hundreds of thousands of documents or millions of images in a couple of hours, whereas journalists might spend weeks or months.'*

(AH) [AI tools] *'Help us to detect checkable facts more quickly. I would say that AI tools are tools of acceleration. I cannot think of any case where the tools make any step of the process unnecessary'*

(GC) *'It is particularly suitable for those areas processing large volumes of data at high speed. And these include from the moderation team in the newsroom to the organization and management of media enterprises.'*

(VB) *'Inside the documentary area, we have to face an increasing volume and variety of data, and we have got very scarce resources.'*

(TV) *'We spent most of the time transcribing data and searching for information, and therefore, we had no time to carry out professional editing.'*

Both journalists and media organizations may benefit from the adoption of AI: these tools can free journalists from repetitive tasks or activities that require little to no qualification, while, for media companies, work is done in a more efficient way, using less resources, thus enabling greater competitiveness.

(MR) *'If AI can automate tasks, journalists will have time enough to develop more interesting tasks: to investigate, interview people, elaborate reports. However, they are spending time transcribing data and writing news stories one by one, instead of creating better outputs.'*

(DL) *'News comes from a data set, so there is no need for the media company to have a whole newsroom working the whole day at the media offices. All the tasks can be centralised and journalists will be able to go back to the streets to search for information, interview people, or investigate.'*

Through the lens of the media company, AI-driven personalisation based on user interests may ensure the content presented to the user is relevant and engaging, thus optimizing user experience. Therefore, mass media using AI achieve a very competitive position in the current fragmented media landscape.

(BM) *'[We are able to] elaborate a personalized cover or newsletter for each user [...] Besides, the mass media business is turning into a new model where the user will have to pay for information and if we are able to know which pieces of news are of interest, people will decide to subscribe.'*

(TC) *'It will help us to increase the listener's engagement, the listening time. [...] localized content will give real value.'*

As AI-related tools can produce pieces of news automatically from datasets, to the media may meet an increasing demand for fact-based news for local communities and minority audiences:

(MR) *'We are able to cover information out of the mainstream, information of interest to citizens but not profitable for companies. Besides, the staff in many local newspapers are scarce, local newspapers are closing and reporters are no longer covering local courts and councils.'*

(DC) *'Local news play a crucial role in a globalised society. That is why we need to personalise contents. For instance, people are demanding information about their small villages. That is already happening, and it will help to solve problems such as the abandonment of rural villages in Spain.'*

Given that this technology is at a very primitive stage, the adoption of AI is linked, in most cases to concept testing to train the algorithms and enable further evaluation and supervision:

(CE) *'It irritates users if the core statements of the articles are no longer up to date, which of course happens frequently. We also want to make sure that particularly high-quality items are*

more often among the recommendations. To achieve this, however, the first thing to do is to define the right metrics.'

As Eugenio López states, all of agents involved in the adoption and implementation of AI must understand that these tools are complementary tools. However, a number of common 'myths' have arisen connected to the infinite potential of AI:

(EL) *'It is not possible to process all information. For instance, you cannot process all the audio information from a football match using AI. We only process political claims or people speaking in turns in an interview, but never juxtaposed sounds as in a debate. [...] And there will always be a percentage of error and lack of accuracy.'*

6.3. Ethical dilemmas

Experts stress the need to carry out ethical studies into the adoption of AI, including both the impact it may have on journalism values such as accuracy or objectivity, among others, and the consequences for final users. According to Jeremy B. Merrill, "strictly speaking, traditional ethical dilemmas connected to the journalism will emerge whether we introduce a new technology or not." Nonetheless, some of the contexts generated by AI tend to amplify traditional dilemmas and might be beyond the scope of the professionals working in a newsroom. For example, as far as content generation is concerned, ethical concerns may arise from the dataset: the property of the data, how it was collected, if the collection processes are in tune with the data protection rules; or an algorithm design that might lead to bias reinforcing and disinformation.

(CE) *'Datasets are never neutral sources. Almost all of them are biased in some way. [...] To gain our readers' trust, we have to be transparent about our work and the input that AI-driven systems have brought in. We have to reflect our quality and relevance standards in journalism to be able to set up these systems in a meaningful way.'*

(IS) *'AI technology is prone to inherit human biases. [...] Hence, it is important to know how machines learn [...] Due to the autonomy of algorithms there might be dissociation from the initial programming.'*

The tailoring of content poses a threat to diversity and plurality of information. Given that users can personalise content, they might receive a distorted view of reality. It is particularly worrying if users make excessive use of tools to personalise news items, since they might find themselves stuck in a filter bubble: surrounded by views and opinions they agree with, while being sheltered from opposing perspectives. On the other hand, media organizations must take into account that algorithms are editorial tools and might distort user understanding of reality and hamper their ability to make balanced decisions.

(TC) *'In the United States, people may say 'I do not want to receive information about the Democratic Party,' or 'I do not want to receive information from Trump again' and if we follow these requests, we are not actually providing people with the news. That is why this content is not subject to personalization. People can personalize, for example, music or films, but not information. An algorithm actually is the modern editorial tool.'*

In terms of media accountability, transparency and plurality, experts point out that ethical principles should be embedded by design. Additionally, media organizations ought to supervise AI outputs, to ensure they promote diversity and plurality, and in order to minimize the risk of bias:

(DC) *'There are two things that we must ensure as a public media: the promotion of ethics principles so that we do not find bias in information, and the promotion of other languages, not only English [...] the commitment to teach the machines how to speak and think in Spanish.'*

(VB) *'It is true that bias is a real risk when it comes to facial recognition. Nonetheless, we are not interested in facial recognition as a description of physical features. What is of interest is to know who the person speaking in an interview is. Is he Alfonso Guerra? Francisco Ayala?'*

6.4. Journalists' perceptions

Regarding perceptions, experts draw a distinction between the way journalists and people from the documentation area embrace the technology.

(VB) *'I am not expecting hostility since people working in the documentation area are too busy. [...] They show less reticence than journalists, since they are used to updating their technical skills continuously.'*

One of the key factors that amplifies resistance among journalists is a lack of knowledge and understanding about AI. Mattia Peretti, for instance, refers to the report *How UK Media Cover Artificial Intelligence* (Brennen et al., 2018) as an example of the ignorance observed in news items about AI published in UK by some mass media:

(MP) *'There are many headlines where you can read the word 'AI.' Those headlines should make clear if they refer to algorithms, machine learning... But unfortunately, AI is the trending word. It is cool, in a way, to talk about AI, and it is easier for journalists to use it, as nobody knows what machine learning means exactly.'*

According to Pablo Sanguinetti, as a result of the journalists' lack of knowledge and understanding about AI, they tend to write sensationalist headlines reinforcing the already existing antipathies. As an example, he refers to an article published in *The Guardian*: "A robot wrote this entire article. Are you scared yet, human?" (2020). The article focused on the capabilities of GPT-3 technology to generate text, from a distorted perspective:

(PS) *'The newspaper presented it as an article completely written by a robot from the beginning to the end, and it was really controversial [...]. The truth is that the editor of the article states that they used AI to generate eight different pieces of text and they used them as a draft. Then, they had to put it together and an editor had to correct the final text.'*

In spite of the fact that journalists are already using AI tools, the interviewees highlight the disconcerting reaction these professionals show when asked about the adoption of this technology in newsrooms.

(TV) *'The concept of AI is distorted, everything is called AI, and that is why there is so much confusion, fear and false prospects.'*

Finally, the current context characterized by political and financial instability reinforces the fears of journalists and mass media industry as far as embracing a new technology is concerned.

(DL) *'It's not only a question of the implementation of the technology itself. The problem is the business model of the media. [...] It is the general background of the industry immersed in a whole transformation due to the digitalization and an economic crisis.'*

6.5. The future of journalism

6.5.1. The human factor

The interviewees place especial emphasis on the role of the human journalist as an irreplaceable agent and as the professional that must supervise AI outputs:

(DC) *'AI is not going to make journalists redundant. On the contrary, it will allow them to undertake new projects [...]. Technology will expand our capabilities. However, we are human beings, and as such we have sense of humour, irony, sarcasm, empathy, feelings [...] AI may know how to process data, but it is not able to explain why they do so.'*

(AH) *'The people I work with are very qualified [...] it is not like the robot you see in a factory putting pieces together, it is very different work.'*

(JM) *'There are many areas where AI can help people to do their job more efficiently. However, there are fewer areas where AI is going to do the whole thing.'*

(PS) *'Ethical problems are inherent to AI. That is why we cannot leave a robot alone to do all the work by itself without supervision. Journalists will have to manage the algorithm, understand how it works and supervise what it is doing.'*

Nonetheless, in terms of supervision, despite the fact that ensuring the ethical and quality standards of the outputs created by AI is indispensable, the volume of data processed and outputs obtained in some areas such as documentation may mean that only a part of the work can be supervised. At the same time, however, it may be feasible to supervise specific tasks such as content verification or news writing, in the documentation area:

(EL) *'It is a double-edged sword. We cannot say that we will supervise every output. We can examine a sample, but not all the content processed by a machine. It would simply be impossible due to the content processed by the machine and would involve duplicating work.'*

6.5.2. Journalist training and new profiles

The interviewees highlight the importance of including AI training for journalists at university. This point is particularly relevant: journalists will be able to achieve a comprehensive approach to technical developments whilst at the same time they will put aside fears and debunk false beliefs connected to the adoption of AI. However, there is no general consensus on how to teach journalists so that they acquire the abilities and knowledge needed or which technical skills are required to perform specific tasks efficiently in the context of unlimited AI tools.

Table 1. Training for journalists.

Should journalists learn the principles of AI at the University?	What should be the level of knowledge / expertise?
<p>(MP) <i>'At universities, they should start considering this topic as part of the curricula [...] because people working in the newsrooms won't have the time or resources to train their journalists once they are in.'</i></p> <p>(CE) <i>'Absolutely! Journalists at least have to be able to understand what those algorithms are capable of, what kind of problems they can solve, how they have to be included into our workflows. Thus, more newsrooms would be able to report on algorithmic accountability.'</i></p> <p>(DC) <i>'Subjects on new technologies are crucial, and they should be included from the beginning of the degree.'</i></p> <p>(PS) <i>'We cannot leave this technology managed only by techs. People from humanities will be needed in the design process'</i></p> <p>(IS) <i>'Education and training is essential, we may focus on the editorial role of algorithms and how decisions made by algorithms can have serious social implications.'</i></p> <p>(VB) <i>'To introduce these technologies in the curricula of the degrees is, undoubtedly, a key point. [...] Young journalists will enter the media with a fresh vision of the work.'</i></p> <p>(TV) <i>'The advance of technology is unstoppable, but education goes at a slow pace [...] And we have to bear in mind that when we implement AI tools in a newsroom, we involve not only journalists and people from the documentary areas, but also end-users.'</i></p>	<p>(AH) <i>'AI tools are actually software tools and they [journalists] do not need the level of expertise needed for coding. It is different from the skills that the journalists need to be able to communicate properly.'</i></p> <p>(MP) <i>'All the journalists will not require skills on how to create automated content, how to personalise content or how to use machine learning. This level of expertise will not be needed in all the positions.'</i></p> <p>(MR) <i>'It is important that journalists learn how to programme in order to understand what is behind algorithms and the criteria they follow.'</i></p> <p>(DL) <i>'There no need for a journalist to learn how to programme, but they need to understand the basic principles to use these tools or collaborate with a coder.'</i></p>

Source: Own elaboration.

As Eugenio López states the adoption of AI will lead to the advent of hybrid profiles, transforming current roles into others characterized by a mixture of skills from the fields of journalism and documentation. Therefore, it will give rise to resourceful professionals:

(EL) 'What prevents a team from the documentary area from generating content? They are able to manage past and present information and, therefore, create a piece of information or the context of an item of news for the journalists. [...] Maybe we are talking about a new profile, the 'knowledge manager.'

7. Discussion and conclusions

This explorative paper meets the objective established initially in terms of addressing the impact on AI in newsrooms, from the perspectives of journalists, experts and academics leading the work on AI. Within this framework, the interviewees describe a twofold reality: On the one hand, AI brings together new market opportunities for media companies, and increases the journalists' satisfaction with their work. On the other, AI tools augment journalists' antipathy and fear, and requires a change of mind-set in media companies, whilst, at the same time, leading to an increase in some ethical issues. Focusing on the first dimension, AI tools increase both production and efficiency, thus allowing media companies to compete against social media and overcome the global financial crisis of this sector. Additionally, AI enhances journalists' working conditions by freeing them from low quality and repetitive tasks, and helping them to save time and focus on qualitative reporting, investigation or searching for witnesses and information. As a consequence, they are able to focus on creating quality human-crafted journalism. Hence, it is suggested that AI may lead to a return to the essence of journalism, leaving behind the current Post-Fordist model in which journalists are merely fact transcribers. From this perspective, AI may add more value to journalists' outputs and to the whole profession.

On the other hand, media professionals distrust technology. According to the interviewees, journalist hostility is due to their limited knowledge, the possibility of being made redundant by a robot or because of a lack of skills, and the belief that AI tools will erode the essence of journalism. Nonetheless, interviewees point out that even the most advanced AI tool will have an auxiliary role and will work under human supervision. At this point, education and training play an essential role in building critical thinking and, at the same time, in overcoming fears and false myths related to these technologies.

The two areas that seem to be the priority are content generation and personalization. AI related tools offer the opportunity to generate large pieces of news covering a huge array of topics not covered before, thus reaching a broader audience. Even users themselves may be able to create their personalized news agenda and decide the content they want to receive. Nevertheless, as tools gain in autonomy, concerns about quality and plurality arise: content personalization might provoke lack of diversity and reinforce users' prior beliefs by creating filter bubbles and echo chambers. Furthermore, as algorithms are editorial tools, they might erode the editorial control of the media, provoking bias at various levels of production (input, throughput and output). Although the malicious use of AI tools is known to enable the creation of highly convincing fake content such as deep fakes, those same AI tools could reverse the situation when used by media companies in fact-checking tasks. However, the possibility that an algorithm may identify a piece of news as a hoax and create the aforementioned filter bubbles is also conceivable. As a consequence, supervision is a priority, although due to the countless volume of outputs generated by AI, supervision is not always feasible. Finally, regarding transparency and accountability, given that professionals from programmers and information technologists to journalists and editors are involved in the design process, implementation, and end-use of this technology, the question of the demarcation of responsibilities poses a serious challenge.

From this point of view, the creation of codes of ethics and statements of core values taking into account all the levels of production and all the agents involved in the design and use of these tools would be desirable. Codes of ethics should compel all the agents from the designers to the journalists, so that ethical values are embedded by design, the norm by default, to be strictly followed by professionals applying these tools. Additionally, it should include a delimitation of responsibilities agreement approved by all the parties in order to define responsibilities related to quality, compliance, transparency and accountability. This will ensure that all the phases of the process, from design to application, are undertaken within the framework of the ethics.

Finally, the limitations on research due to the interpretative approach are recognized here; therefore, further research on the impact of this technology will be needed.

The author would like to thank to Paco Segado Boj for his assessment during the first steps of research.

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