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Automation, bots and algorithms in newsmaking. Impact and quality of artificial journalism

Miguel Túñez-López [] [] Professor at the Department of Communication Science from the University of Santiago de Compostela (USC), Spain miguel.tunez@usc.es
(Corresponding author)

Carlos Toural-Bran [] [] Professor at the Department of Communication Science from the University of Santiago de Compostela (USC), Spain carlos.toural@usc.es

Cesibel Valdiviezo Abad [[CV](#)] [] [] PhD candidate at the USC and Professor at the Communication Department of the UTPL, Spain kcvaldiviezo@utpl.edu.ec

Abstracts

[ES] Introducción: Las transformaciones en el periodismo se han considerado una modernización del proceso de producción informativa y una actualización del proceso para incorporar los avances en tecnología. El cambio en las últimas cuatro décadas ha derivado de un periódico hecho manualmente en maquetación y composición tipográfica a un relato informativo online con textos noticiosos creados por máquinas preparadas para imitar mediante algoritmos el modo de estructurar y escribir las noticias y sustituir al periodista. El periodismo artificial está cada vez más presente en los medios, lo que comienza a abrir debates deontológicos, laborales y sociales. **Metodología:** Se realiza un estudio bibliográfico para identificar y sintetizar los principales informes y estudios sobre automatización en periodismo. También se realiza un análisis comparativo de noticias deportivas redactadas por algoritmos y noticias elaboradas por periodistas humanos. **Resultados:** Se refieren casos del impacto de automatización en medios de referencia, se identifican patrones narrativos de noticias generadas por ordenador **Conclusiones:** Se perfilan tendencias de futuro asociadas a los cambios derivadas de la progresiva implantación de la inteligencia artificial en los medios y en sus relaciones con las audiencias.

[EN]Introduction: Changes in journalism have been considered a modernization of the news production and an update of the process to include advances in technology. The transformation over the last four decades has resulted from a handcrafted newspaper both in layout and typesetting to an online story with newsworthy texts created by prepared machines that, using algorithms, imitate structures and the way to write the news and substitute journalists. Artificial journalism is increasingly present in the media, which starts to open deontological, labour and social debates. **Method:** A bibliographic review is carried out to identify and summarize the main reports and studies in journalism

automation. Also, a comparative analysis of sport news written by algorithms and by human journalists is conducted. **Results:** Cases of the impact of automation in reference media are referred, and narrative patterns of computer-generated news. **Conclusions:** Future trends are identified and associated to the changes resulting from the ongoing implementation of artificial intelligence in the media and their relations with audiences.

Keywords

[ES]: Periodismo artificial; periodismo algorítmico; periodismo automatizado; periodismo robotizado; *newsmaking*; inteligencia artificial.

[EN]: Artificial journalism; algorithm journalism; automated journalism; robot journalism; *newsmaking*; artificial intelligence.

Contents

[ES]: 1. *Newsmaking e inteligencia artificial* 2. Del periodismo artesanal al periodismo artificial 3. Deontología, ética y *roboética* 4. ¿Redacciones sin ordenador, periodismo sin periodistas? 5. Metodología 6. Principales estudios sobre automatización en la elaboración de noticias 7. Calidad del periodismo artificial. Análisis comparativo de noticias escritas por humanos y por algoritmos 8. Conclusiones 9. Bibliografía

[EN]: 1. *Newsmaking and artificial intelligence*. 2. From artisan journalism to artificial journalism. 3. Deontology, ethics and roboethics. 4. Newsrooms without computers, journalism without journalists? 5. Method. 6. Main studies on automation in newsmaking. 7. Quality of artificial journalism. Comparative analysis of news written by humans and algorithms. 8. Conclusions. 9. References.

The automation of functions has reached the last stage of newsmaking and more and more media include computer-generated news. Artificial journalism makes its way for decades now, but it is now when that silent process starts to be visible, as advances in the way of doing journalism in the last decades have been interpreted as a modernization of production dynamics and an update of infrastructures to adapt to the new ways of reporting and disseminating.

Automation replaces journalists with algorithms, but it is not a threat but a new way to construct the story, as the informative proposals of any platform. New functions, algorithms and bots as assistants in the capture of stories and improvements are in the spotlight. The use of artificial intelligence (AI) in news production shows cases with a total replacement of direct human intervention during newsmaking. Machines have moved from being a support to be those responsible for performing the task. Journalism without human journalists is already possible.

The article makes a review of the progressive emergence of artificial journalism, which is produced and disseminated through an automated process without direct human intervention. Also, it identifies the main scientific studies and reports on new prepared by computer programs/algorithms, reviews recent actions of reference media to automate the production and dissemination of news, pays attention to the need of a new ethics for the production of AI products, and compares similar texts written by algorithms and human journalists.

1. Newsmaking and artificial intelligence

By linking artificial journalism and intelligence (AI), in many cases the projection of possible interactions between the two has been limited to consider, in a restrictive way, the use of what is called weak (or narrow) AI, as newsmaking is approached as the activity of a machine that only executes programmed actions. Implication is oriented, however, to be executed with strong (or general) AI,

which is the one that adjust machines so that they imitate the way in which human process information and even to be able to react in order to provide solutions.

AI, as a whole, has evolved from being applied in purely-reactive machines –which did not even learn about themselves-, to machines with the ability of storing, albeit on a temporary basis, and making decisions based on their experiences. The next step is to give them the ability of self-knowledge and potential to project themselves in future actions; that is to say, AI to program objects able to understand alien emotions and manifest own emotions. It could be known as the application of the theory of mind, an expression coined by Premack and Woodruff (1978), as they have the human ability of interpreting conducts through mental states, as well as own and external feelings to prevent behaviours.

AI application in Communication coincides with the boom of digital environments that are the result of universalization of massive access to the Internet that multiply the possibility of obtaining, disseminating and processing data. Internet provokes the restructuring of the media, the emergence of new platforms, cybermedia and the incorporation of hypertextuality, interactivity and multimedia to the journalistic profile. Parallel to changes in products and platforms, the technological development enters in content creation and writing of news based on algorithms to be generated by computers.

Defined as a finite set of specific descriptive rules, algorithms are the abstraction of a step-by-step procedure that takes an input and produce a result to attain a defined product (Diakopoulos 2015). Applied to journalism, algorithm formulations can prioritize, classify and filter information and even be applied as metrics for analysing audiences, for determining coverable topics and for writing stories according to the obtained information in databases (Anderson 2012; Carlson 2015).

The use of algorithms allows machines to autonomously generate textual and graphic journalistic products from data. “Once developed, not only can algorithms create thousands of news stories for a particular topic, they also do it more quickly, cheaply, and potentially with fewer errors than any human journalist. [...] Within this context, algorithms are able to generate news faster, at a larger scale, and potentially with fewer errors than human journalists” (Graefe, 2016, 5).

Carlson (2015, referring Mayer-Schönberger and Cukier, 2013) stress that distinction by ensuring that the automated generation of news is the result of the intersection between journalism and big data. In his opinion, computers may be used to retrieve information, and data mining processes may be used to discover new knowledge of structured and unstructured random data silos (Wölker, 2018) and allow, also, in order to complete the process, the introduction of interactivity with consumers (Flew et al., 2012).

The emergence of computers in news-content creation goes beyond digitisation of newsrooms. The origin of automated generation of news is linked to data journalism (Gynnild, 2014, points to Meyer as pioneer) and based on computer-assisted reporting (CAR), which served as a starting point of what became known as precision journalism, defined by Meyer as the application of social research and behaviour methods journalism through the in-depth exploration of databases, surveys, and a general mix of computing and social sciences (Meyer 1973).

The evolution from an algorithm for analysing to an algorithm for writing was favoured by the semantic web and the application of AI for the storage and processing of data, because “data and data-driven journalism emphasizes finding stories in data sets, while computational journalism emphasizes the merging of computing and journalistic values in tool creation and method application” (Stavelin 2014, 86).

2. From artisan journalism to artificial journalism

Artificial intelligence started changing journalists' routines by automating search functions, classifications and information processing. At present, it is being installed in newsroom tasks through what is labelled as automated journalism, defined as “algorithmic processes that convert data into narrative news texts with limited to no human intervention beyond the initial programming choice” (Carlson, 2015: 417) to “the process of using software or algorithms to automatically generate news stories without human intervention—after the initial programming of the algorithm, of course” (Graefe, 2016), interrelating “computing, social sciences and communications” (Flew et al, 2012).

It is also referred as algorithm journalism (Diakopoulos, 2015; Dörr, 2016) and robot journalism (Oremus, 2015), but it is always identified as a technological solution to produce news and to carry out journalistic tasks such as reports, curation and even data analysis and visualization (Gao et al., 2014; Shearer, Basile and Geiger, 2014; Broussard 2015; Carlson 2015; Young and Hermida 2015).

However, if we focus on journalists and results, that is, on the text, the experienced process is an evolution towards artificial journalism, as a counterpoint to an artisan journalism in which newsmaking in newsrooms referred to a manufactured process. News promoted through algorithms represent a kind of journalism where human intervention can occur only in instances alien to the journalistic process, as it is limited to the design of the algorithm by computer engineers and to the design and creation of databases and writing templates.

We would be, then, before news prepared and published from processes executed by machines in which there is no intervention of any journalist to write the text. In four decades, there has been a radical transformation in the way of producing and disseminating news. From a printed journalism, using a linotype machine made of artisan tin matrixes, and with a handmade composition of pages to adjust the real text to the available space, we have gone to a journalism of automated dissemination from mobile devices. In the past, we had mock-ups drawn with the hand in a pattern paper, page by page, with the help of the typometer to calculate typographical measurements and set characters necessary to fill each space based on the size of the box and the chosen letter body. Now, we work with unlimited templates in terms of space, where textual languages, audio and visual elements coexist. We have replaced bi-directionality through postal mail and phone calls from fixed terminals with real-time interaction with video, voice and texts through all kind of devices and platforms.

Journalism has gradually evolved towards computational journalism first and, then, towards digitised journalism, which opens up the doors of journalistic times and spaces to an emergent artificial journalism which comprises informational texts created through algorithms that imitate production routines of journalists. That imitation is the task of the machine that has been programmed to transform data series in news stories with all the conventions of newsmaking both as regards linguistic and paralinguistic series, and respecting the guidelines of the so-called informative style.

In artificial journalism, cognitive intervention is replaced by the silent, invisible performance of the algorithm. It is referred to as a robot, as a metaphor or synecdoche that allows reference to the intangible performance of the computer process with which a creation process is recreated in which the assembly and interpretation of signs and symbols is carried out by machines that have been programmed to execute that function through processes of imitation of cognitive dynamics.

All denominations refer to different activities, but related to the use of computer resources and platforms. Multiple tags generated sometimes refer only to a specific use of technology. As Vázquez and Codina (2018: 761) synthesize, terminology for the concept of computational journalism is very diverse, as there is not a clear line that limits its reach. Coddington (2015) tries to unravel the complexity of the concept under the idea of the ‘journalism’s quantitative turn’, which stands out for

promoting networking, intensively using big data, and encouraging public participation. Hamilton and Turner (2009) understand it as the set of tools that journalists use to discover, explain and distribute stories, which also use algorithms to create them. When reviewing the differentiation of labels, they remember how technological transformation has led to talk about computer-assisted reporting (Houston, 2014; Meyer, 1999), augmented journalism (Marconi; Siegman, 2017); and data journalism and data-driven journalism) (Parasie; Dagiral, 2013) (Vállez and Codina 2018, 761).

Regardless of its name, newsmaking using computer programs involves the identification of repeated routines that can be identified and encoded, and it is based on the simulation of natural language through a software that allows the robotic production of news pieces, but with identical characteristics than another elaborated by a human journalist.

Artificial journalism does not directly work on a reality defined by facts, but a coded reality (mainly with data), on which algorithms work, which derives interest in four aspects:

- the ability of AI to replace the cognitive part of the journalistic practices and codify it algorithmically.
- the process of elaborating databases.
- the rules for building algorithms.
- the implication of robots in the possible generation of fake news.

The article focuses on the computerization of newsmaking (which are assumed to be truthful) to be disseminated in the media (which are supposed to be rigorous and interesting for its credibility), so it does not go into the fourth point concerning the implications of AI and fake news.

3. Deontology, ethics y roboethics

Automation of functions and changes in work environments is a reality that affects the entire world, not only journalism, but the computerization of newsmaking opens debates that go beyond the substitution of individuals by machines, as they move to deontology, the veracity of contents and the creation of new control spheres over the information published.

The axis of interest in controlling contents disseminated by the media would shift, as it would cease to be in the story, the final newsmaking process that is the sole responsibility of the journalist / editor (Túñez and Toural, 2018). In an automated process, the struggle for control would no longer focus on the elaboration of the text because it would be mechanically executed by a computer system, and would become focused on three points:

- in the process of creating these databases.
- in the ability to decide on the availability of information accumulated in databases (not always publicly available).
- in the interrelation bases that configure the programming to automate writing processes, that is, algorithms.

The centre of attention shifts because the construction of databases and the design of the algorithm would be real determinants of the final result. The demands for rigor and honesty and the requirement of impartiality in the news could no longer be made to the text but to the previous phases of data storage and ordering and to the computer creation of the algorithm, which is responsible for interpreting those data and converting them into a news story.

This opens the door to the debate on ethics and deontology in artificial journalism that connects with the report on Robotics that establishes and Ethical Code of Conduct approved by the European

Parliament in 2017. As Salazar explains, it is necessary to deepen the roboethics, differentiating the rules for creators and robots and for created robots, because “we should not confuse ethics in robotics with ethics in machines, that is to say, an ethics that force robots to align with ethic rules” (2018, 311).

The debate about the need to monitor new relationships between machines and audiences is also promoted. As noted by Diakopoulos (2019), it is necessary to reinforce the role of the public spirit or the accountability of journalism and, at the same time, to maintain a watchdog role over the ethical use of algorithms to generate news contents in newsrooms.

As Marconi and Siegman (2017) pointed out, the debate on ethical aspects raises claims for artificial intelligence to adhere to ethical values and the standards existing before their incursion in newsrooms. That is, the transparency of automation programs, because “readers deserve to be given a transparent methodology of how AI tools were used to perform an analysis, identify a pattern, or report a finding. But that description must be translated into non-technical terms, and told in a concise manner that lets readers understand how AI was used and how choices were made” (Hansen, Roca-Sales, Keegan, King, 2017), which make it necessary to review thoroughly ethical, moral and operating considerations of computer-generated news, as AI tends to concentrate more power in the hands of the already powerful, “as it has already been seen in Google, Facebook and Twitter” (Lindén 2017, 73).

The concern also focuses on the effects derived from media practices in the management of relationships with audiences, because the generation of news content dominated by the clickbait can lead the news towards sensationalist approaches if the quest for virality dominates the journalist role as editor / reviewer to increase control over what is disseminated. “Just like social media platforms, aggregator apps will need to start facing up to their wider responsibilities this year and that will increasingly mean putting in some kind of editorial oversight” (Newman et al, 2019: 33). In short, it is a matter of adjusting the use of the algorithm in the process of newsmaking without leaving all decision-making about valuations, hierarchy and content generation in the hands of the algorithm.

In December 2016, Obama’s administration made publicly available the report of the Executive Office of the President on Artificial Intelligence, Automation and the Economy, which focused in the need to design public policies and pointed out five future lines of action (The White House, 2016: 26):

- Positive contributions to aggregate productivity growth;
- Changes in the skills demanded by the job market, including greater demand for higher-level technical skills;
- Uneven distribution of impact, across sectors, wage levels, education levels, job types, and locations;
- Churning of the job market as some jobs disappear while others are created;
- The loss of jobs for some workers in the short-run, and possibly longer depending on policy responses.

4. Newsrooms without computers, journalism without journalists?

The interest for computer-generated news contents is an area of concern for journalism in this second decade of the 21st century, but its impact on journalism goes back almost half a century in weather information (Meehan, 1977; and Glahn, 1970), and, in the last decade of the 20th century, in topics from the sports and economy sections (Meehan, 1977). That decade could mark the change of trend or the beginning of the real emergence of automation of news with the financial, data and news software that companies such as Bloomberg LP started to offer, with a portfolio of customers that included agencies and reference media such as Thomson Reuters and the New York Financial Press (Winkler, 2014).

The robotisation of news production has been a constant since computerization arrived to newsrooms. Changes in newsmaking have been progressive and continuous, but they have been done in a way that always seemed to affect the mode of news production but not the elaboration of content directly. Even today, journalists do not have a clear perception that they already share time and space of news broadcasting with automatically-generated contents with algorithms. A recent study based on interviews to 366 Spanish journalists confirms that, “among journalism professionals there is still no clear awareness that newsmaking through algorithms has ceased to be a possibility to be a reality”, and “it is even unknown that some international media and agencies have already replaced their editors with computer applications to elaborate content that they transmit to their audiences” (Túñez, Toural and Cacheiro, 2018, 756).

The Oxford University and the Reuters Institute pay attention in their annual report of predictions 2019 to the example of the Chinese mobile platform *Toutiao* (*Jinri Toutiao*), which works with algorithms that generate personalised news adjusted to the interests of more than 120m users with average dwell times of over an hour each day. “Now these AI driven apps are spreading across Asia with Newsdog one of the most popular aggregators in India and Toutiao’s owners, Bytedance, investing in similar apps in Indonesia” (Newman, 2019: 32).

The report refers to other examples that help to identify the progress of the application of AI in the media and the impact of automation on content and relationships with stakeholders: the BBC project in what it calls public service algorithm to literate the audience on the use of algorithms and how to customise the use of applications correctly; the Finnish public broadcaster YLE, which developed *Voitto*, the first application that uses an intelligent assistant to establish a continuous dialogue with users, with whom generates about 100 stories and 250 images per week. Also, advances in automated simultaneous translation of contents into other languages, with examples such as the Finnish news agency STT, which translates news into English and Swedish, and the Associated Press, which expects to close the year 2019 with 40,000 automatically-generated news and strives to generate applications to verify real-time multimedia content. The report also refers to *DataMinr*, a real-time filtering tool for Twitter content so that journalists select topics of media interest.

The global scenario is a constant tickle of examples. The news agency *Xinhua* announced in 2018 “a new kind of newsroom based on information technology and featuring human-machine collaboration” (http://www.xinhuanet.com/english/2018-01/09/c_129786724.htm) and presented the platform *Media Brain* as the way to “bring cloud computing, the Internet of Things, Big Data and AI technology into news production, from finding leads, to news gathering, editing, distribution and finally feedback analysis”. The Chinese government’s forecast is to build an AI development park in which it is estimated that 13.8 billion yuan (around 2 billion euros) will be invested in five years. The goal is to be world leader in AI by 2030 (<https://www.cnbc.com/2018/01/03/china-is-building-a-giant-2-point-1-billion-ai-research-park.html>).

To these ads is added the intention of Google and Microsoft. Google is expected to open a research centre in Beijing (<https://www.bloomberg.com/news/articles/2017-12-13/google-to-open-beijing-ai-center-in-latest-expansion-in-china>) oriented to basic AI in publications, academic conferences and knowledge exchange. Microsoft, for its part, will create a lab in Taiwan focused on AI development (<http://www.taipetimes.com/News/front/archives/2018/01/11/2003685571>).

Through the Google Digital News Initiative, Google financed the RADAR project (Reporters and Data Robots) with 622 thousand dollars in 2017, powered by the UK news agency Press Association, in cooperation with Urbs Media. The initiative planned to produce in an automated way more than 30 thousand monthly stories focused on local and hyper-local content in 2018, data chosen for the launching of the pilot program. In November 2018, with validity until August 2019, the Press

Association launched a trial at the disposal of 35 UK regional and local media with the aim of letting them to experiment the service with computer-generated news thanks to its AI system. On their website, they point out that their main goal is to establish a framework of real and effective collaboration between human journalists and technology to increase the production of news about certain local issues that otherwise would not have media coverage. With a geographic segmentation base and the generation of natural languages, the project proposes the search, production and dissemination of local news extracted from high data volumes.

Narrative Science is a tech company founded in 2010 in Chicago by Larry Birnbaum, Stuart Frankel and Kris Hammond and devoted to the creation of journalistic articles through Quill, an Advanced Natural Language Generation (NLG) platform able to analyse data structure to later generate narratives and to customise news, which shows how automation already reaches newsmaking phases that, until recently, were considered irreplaceable.

Experts in Artificial Intelligence recognise that the challenge is to move from programmed machines to machines with the ability to decide how to act on each occasion: robots with autonomy and ability to think and program their reactions. In journalism, the future exit in order to avoid the standardization of tasks and texts generated by machines is to reinforce the contribution of the intervention of people to generate identifiable value in the text through the singularization of proposals and approaches.

That is to say, to reinforce the weight of the cognitive part in the participation of journalists in the process of designing the agenda, which would imply a commitment to escape from scheduled agendas by contrasting personal singularization of informative proposals. Or what is the same, try to avoid the algorithm emphasising the intellectual component that turns the generation of news in a process distanced from repetitive mechanic decisions –production routines– and texts without clichés to differentiate them from repetitive writing in structures and terminology that currently characterises those made by machines. Future is projected together with the need to decouple newsmaking from shared routines in coverage and writing. The agenda-setting should recover the contributions of journalism as a backbone, to the detriment of the calls for events scheduled to be news.

5. Method

The first phase of the research was oriented to identify and systematise the main studies on the use of artificial intelligence for the automation in newsmaking through tracings with inclusive and exclusive keyword chains in WoS, Scopus, ResearchGate and Google Academic. The search was connected through the specific location of reports and researches not located in the tracking results of the aforementioned databases, but referenced in the documents obtained. Also, a thorough study on the interpretation of answers of a previous study (2018) on the perception of news automation by journalists through the analysis of available material was also conducted. The information search was carried out for the first time in January 2018 and was updated twice, in January 2019 and June 2019. The objective of this bibliographic review is to deepen the delimitation of the theoretical corpus and to generate a story based on the synthetic description of these investigations, being a topic that could be considered of growing interest but not yet exhaustively addressed in Communication.

The second phase is presented as an exploratory investigation, due to the lack of previous referential analysis, with a descriptive intent. We worked with a convenience sample composed by data from the National Football League of second division, which were published in the digital version of the newspaper Sport in February 2019.

The content was analysed paying attention to the journalistic genre, informative or evaluative orientation of content, signature and update references, structure, comparison of headline and/or header, comparative of initial paragraph or lead to determine the preferred approach in the piece of

news, used paralinguistic resources and use of links. Computer-generated texts and texts prepared by human journalists (signed) were selected. Both included information of the same match and the same period in order to make comparisons.

Being an exploratory study, there is not a blind hypothesis, and the objective is to find the matrix structure used by computer programs in the creation of informative texts and answer the following research questions:

- Are there significant differences in focus and genre between computer-generated news and those written by humans?
- Are computer-generated texts identified as such? Who signs them?
- Which narrative resources are used? Which paralinguistic codes are used? Are there links?
- What are the differences between texts of the same subject but written by humans and by machines?

6. Main studies on automation in newsmaking

From the results of the detailed analysis of databases and scientific social networks, it can be noted that research focused on the impact of technological advances in journalism (Powers 2012; Karlsen *et al.*, 2014) and the use of computers as tools to increase interactivity with users (Flew *et al.*, 2012), pave the way for works on the application of AI in newsmaking, such as contributions by Kim *et al.*, 2007; Matsumoto *et al.*, 2007; Napoli, 2012; Van Dalen, 2012; Clerwall, 2014; Edge, 2014; Karlsen and Stavelin, 2014; Latar, 2014; Stavelin, 2014; Carlson, 2015; Oremus, 2015; Lecompte (2015); Dörr (2016); Graefe (2016); Fanta (2017); Hansen *et al.*, 2017; Lindén (2017); Marconi and Siegman (2017; Usher (2017), Oppenheimer (2018), Salazar (2018), Vález and Codina (2018), Wölker (2018) and Diakopoulos (2015 y 2019), among others, which reflect a growing scientific interest in the robotic development of journalistic news.

Research from Graefe (2016) and Dörr (2016) stand out, where they identify media outlets using computer-generated news, and the Fanta report (2017) on the use of computer-generated news in European press agencies. They affirm that automated journalism may say what is happening and when, but not why. Renó and Renó (2017) makes a study on the use of algorithms to generate stories in media and agencies. Fanta (2017) contacts 14 national news agencies in Europe (nine admit to being working with automated content and two more say they have it in the pipeline), and shows how automation is changing the way most of them work, but still it has quite few limitations.

Contributions by Diakopoulos (2015) on opportunities and challenges of journalism on algorithm-centred accountability are also referential. Clerwall (2014) analysed quality differences perceived by 46 Swedish students in two versions of an article about an American football game written by humans and robots. The comparison showed that people did not perceive relevant differences between the two texts. Graefe, Haim, Haarmann and Brosius (2016) take up the case to try to answer the reason-why of the obtained results.

The Digital News Reports 2017 from the Reuters Institute and the Oxford University reinforce this trend by offering data of public preferences on news selected by human editors and algorithms. Overall, 54% chooses an automated selection against 44% who opts for a human selection. As regards people under 35, 64% prefer the piece of news written by a robot.

Two years later, in 2019, the report of both entities on journalism trends focused on the consequences of automation in journalism, in news prepared and published by the media and fake contents disseminated on the Internet. Data show that, in 2018, 72% of editors acknowledged that they were

experimenting with AI and that, in 2019, the use of AI is focused on: 1) Using ML to personalise content and create better recommendations for audiences; 2) Automating more stories and videos (so called robo-journalism); 3) Providing tools to help augment and support journalists deal with information overload” (Newman, 2019: 32).

Other studies focus on topics such as perception of informative texts produced, such as contributions by Graefe (2016), Lecompte (2015) (on the benefits of personalization of local information with structured data); Lindén (2017) on the media response to content automation, and Slater and Rouner (2002), who study the response of groups of people from different educational levels and ages to text made by journalists and robots.

Van Dalen (2012) studied journalists’ perception by analysing the reaction of journalists to the launch of StatSheet, a network of sport websites written by machines. Carlson (2015) examined how journalists wrote about the text generation software published by Narrative Science; Young and Hermida (2015) worked on the emergence of news about computer crimes in The Angeles Times, and Thurman (2017) made interviews to 10 journalists from media such as CNN, BBC and Thomson Reuters to gather their impressions.

Results are convergent in their description, although the computerization of newsmaking generates contrasting reactions. Critics with the use of bots suggest that journalism done with algorithms could represent a disturbing model not only for communication but for democracy itself (Anderson, 2011: 541) and also a challenge to the authority of traditional journalists (Usher, 2017).

Those who question robotisation of newsrooms argue that the use of algorithms to create news is a break with the idea of what is journalism, not only because bots cannot ask questions, determine causation and form opinions, but they can be inadequate to fulfil the watchdog role (Strömbäck, 2005), since it is not possible to think of algorithms that become guardians of democracy and human rights (Latar, 2015: 79). They also note that robotisation will have a negative impact on employment, because it will mean the elimination of jobs, and on contents, since it can mean that the media will publish insipid and repetitive news.

However, in general, most studies agree that, as Carlson (2015) points out, journalists react to technological innovation in a complex way that includes attitudes ranging from fear to future to voices advocating for reinvention of professional roles. The most optimistic argue that, with algorithms, content will be more attractive and argue that the news written by computers could even increase the quality and objectivity of the news coverage (Graefe, 2016) or argue that, thanks to automation, content can be produced faster, in multiple languages, and possibly with fewer errors and biases.

Clerwall (2014) notes that robotizing is perceived as a form of collaboration with the human journalist or a distribution of the workload, as it frees them from tasks. In this sense, Flew (2012) explains that, when the machine releases the journalist from the job of obtaining data, it allows him to focus on verification of news, on counteracting fake news (Graefe *et al.* 2016) and on making exhaustive reports and research while routine tasks are covered by algorithms. Economic reasons are also pointed out because they could help media outlets to offer a wide range of stories at a minimal cost (Van Dalen, 2012), and also opportunity reasons, as they could be a support in the scope of journalism rather than a rival that could jeopardize the job (Cervera, 2017: 108-109).

Research has also been carried out on the use of robots in social media, especially the extraction of features such as temporary activity, network structure and user feelings to develop automatic learning classifiers to detect the automated management of profiles (Chu *et al.*, 2010; Tavares and Faisal, 2013; Dickerson, Kagan and Subrahmanian, 2014; Ferrara *et al.* 2016;). Hyper-segmentation of social media users allows tracking their digital fingerprints to adapt to their preferences (Keeney, 2015).

Defined as "automated social actors", social bots are designed to act similarly to humans (Lokot and Diakopoulos, 2016) in the management of contents and interactions (Hwang, Pearce and Nanis, 2012: 40) and to disseminate positive content, expand fakes and generate non-desired relations (spam). There is a difference between algorithm, which writes, and the robot, designed to participate in the dissemination of information on social networks (Lokot and Diakopoulos, 2016), to rebroadcast and aggregate web contents web (Mittal and Kumaraguru, 2014; Starbird et al., 2010) and to identify newsworthy events for further dissemination (Steiner, 2014).

Although the first applications of information automation are linked to large media, authors such as Lecompte (2015) relate robotisation of content with small media, because it would offer greater benefits if it were oriented to personalise local information thanks to structured data without stop growing by betting on expanding coverage.

Oppenheimer (2018) jumps from the scientific support to social dissemination to disengage the vision of the impact of AI in different professions. In journalism, it stands out that automation not only allows writing the news. It also updates information immediately as data change, so it can be considered that it writes and disseminates almost in real time. He also notes that AI makes it possible to offer personalized products to subscribers and frequent readers based on their habits, and even offer different languages to adjust them to their consumption habits (for instance, it is possible to include video just for users who usually click at). It synthesizes to the maximum by suggesting that, if a work can be easily explained, it can be automated, and when explaining that algorithms are like babies that learn from examples and behaviours they see. He forecasts a future of collaborative journalism and multimedia journalists, implementing popular applications and platforms in the profession.

The scientific literature review has identified meaningful research on automation of news in Spain, such as analysis made by Salazar (2018), Vázquez and Codina (2018), Túniz-López, Toural-Bran and Cacheiro-Requeijo (2018) and Rojas-Torrijos (2019), which collects a list of 19 media outlets and agencies that use bots to produce sport information and points out that the most recurring genres, formats to produce automated contents are: pieces of news, brief news, chronicles, tweets and graphics. Fanta (2017) refers in its study of European agencies that the Agencia Efe has not yet considered their use, while some of its delegations do work with small systems of automated data processing. Pioneer experiences have been also identified, such as Vocento, which creates service information on beaches and sky resorts in a project to automate the update of contents called Medusa. Companies such as Narrativa are between the pioneers in orienting to the production of sports reporting in real time for the publishing sector, which has been already seen with initiatives of the newspaper Sport, which reports on football matches of the Second Division B.

Túniz-López, Toural-Bran and Cacheiro-Requeijo synthetize the panorama in a world map of media and companies that use automated newsmaking. As regards the degree of knowledge about robotisation penetration, as well as the attitude of journalists, results are descriptive and can be summarised as follows (2018: 754-757):

- It is an unknown reality.
- It is not considered to have a great impact on the profession.
- Robots are seen as a complement, not a substitute.
- News created through artificial intelligence are only seen as a complement to those produced by human journalists.
- It is admitted that complementary information topics could be robotised, such as the weather.
- Most of them think that newsmaking could not be robotised, especially in large areas, such as politics and society.

- The company is seen as potentially interested in automation, since it would have a positive impact on its business model and would increase productivity and reduce production costs.
- It could be given more for less. Cost reduction is linked to an increase in the amount of information available to the public.
- Impact will be greater on employment than on quality of products.
- The image of the profession will not be greatly affected.

The survey included two open-ended evaluative questions to deepen the perception in two aspects: real possibilities of replacing human journalists in non-mechanical tasks and the interest of companies in the sector to promote robotisation of newsrooms. Only one in then journalists (11,8%) replied in the affirmative to the question –without revealing the Korean example– if a robot could rebroadcast football matches. Some arguments against are meaningful and descriptive:

- *“The emotions and narratives of these events would be lacking”.*
- *“It depends on what is understood by broadcasting. Tracking movements is possible; interpreting players’ gestures, for instance, is more difficult”.*
- In the case of the reasons that could motivate companies to robotise newsmaking, saving costs is almost the unanimous response:
- *“Cost savings despite a noticeable decrease in information quality, but this (information quality) has no relevance for media companies”.*
- *“Improving SEO positioning, knowing better audience preferences to improve ad insertion with specific contents and sell better to advertisers”.*

7. Quality of artificial journalism. Compared analysis of news written by humans and algorithms

The analysis of information published by the newspaper Sport in its online version is limited to news on match results of Second Division. Two groups can be identified according to the priority geographical area of dissemination, and the content is reviewed attending to frequency, dating line, update, text structure, approach, header, lead and content, visual elements, paralinguistic resources, interactivity and repetitions.

7.1. Artificial journalism

The analysis of news written by algorithms shows that texts are informative. There are not evaluative elements, although it is a topic that usually gives space for chronicles as the format to textually reconstruct the event.

News pieces are the dominant genre. They use a repetitive narrative structure in which it is possible to identify a constant pattern in the sequential ordering of data. Referential standards adjusted to the possible informative interest of the reader are identified: participating actors, results and consequences of the result in the global classification.

The structure maintains, in all analysed cases, a succession of paragraphs that respects a content order that could be configured as follows (Table 1):

- Segment 1. Lead: paragraph 1: lead including the match results.
- Segment 2: Chronological story of the match. The second paragraph includes data of what happened in the first half of the match. If there are goals, they are highlighted; if not, the

absence is mentioned as a remarkable fact. The third paragraph of the piece gives information about the second half.

- Segment 3: Incidences. Paragraph 4 reports whether or not there were changes and substitutions, and paragraph 5 the yellow and / or red cards shown during the match.
- Segment 4: Projection and consequences: paragraph 6 refers to the classification and the position of the two teams before and after the match. The final paragraph remembers who the two teams are playing against in the next journey.

PATTERN STRUCTURE				
Segment 1	Lead	Paragraph 1	Sentence 1	Match result
			Sentence 2	Classification before match
			Sentence 3	Classification after match
Segment 2	Chronological story	Paragraph 2	First half	
		Paragraph 3	Second half	
Segment 3	Incidents	Paragraph 4	Changes and substitutions	
		Paragraph 5	Shown cards	
Segment 4	Projection and consequences	Paragraph 6	Classification	
		Paragraph 7	Rivals in the next match	

Table 1. *Structure of the algorithmic pattern.* Prepared by authors.

Among all cases, the result is the open item through differentiated expressive formats, as a repertoire or catalogue of possible openings with variations that are repeated day by day.

The lead also presents a reiterative internal structure: referential start with narrative variations but always based on the result, background of the fact to unify the significance of the match, and consequences of the result on the classification of teams playing the mentioned match.

Repetitions in structure compensate with variations in the writing to avoid that the product becomes an obvious repetition for the readers, since all matches are played almost at the same time and the news share page and space in the web. A way of narrating with slight variations of terms is coined. The use of turns and football expressions approach an interpretative model, but only apparently, to give content to a data story. Descriptive narrative never evaluative, except in generic labels such as “*puntos valiosos*” (valuable points).

7.2. Human journalism

The analysis of news written by human journalists shows that analysed pieces adjust to the elements of the chronicle, which is a text including opinions and thoughts of the author.

There is not repetition of structures, although the lead maintains the same three elements than the texts written by an algorithm: result, background, consequences.

HEADER		
Part	Artificial journalism	Human journalism
Headline	Short sentence focused on the result in text and number	Short evaluative sentence focused on projection and consequences
Subtitle	Periphrasis of headline that does not provide meaningful information	Explanation of results and reason-why of that outcome
Signature	Collective anonymous, name of the media outlet.	Author

Table 2. Comparison of headers. Prepared by authors.

Qualifiers and future projections are used based on the journalist’s personal interpretation. These contents include authorship in credits, as corresponds to evaluative and opinion journalistic genres.

Coverage priority is given to the activity of teams located in the geographical scope of the newspaper, Catalunya. It is part of the strategy to increase online visits and gain audience. The coverage of actors outside the priority location is automated and therefore it does not always match with the informative expectations and requirements of the preferential / usual target of the media outlet. The new (online) public does not usually consume simultaneous products and journalistic pieces, since the expected behaviour is that the reader goes to the web to know the result and the highlights of the match, not to make a detailed reading of everything happened in the journey, which interests only if the action of other team can affect the classification of your team.

A clear resource strategy is identified to gain only audience while attending the priority geographical target in a personalised way. It is the resource of the audience as a strategy for incorporating topics and, in that case, that coverage is derived to newsmaking teams served by algorithms to satisfy demands that do not fit in the priority target.

LEAD					
Authorship	Artificial journalism				Journalist
Content	Informative				Evaluative
Genre	Piece of news				Chronicle
Focus on	Both teams / Result	Time	Result	Team / Result	Future prospect
Initial sentence	<i>El Málaga y el Almería empataron a uno en el partido</i>	<i>El pasado domingo el Real Sporting ganó fuera de casa 0-3 ante el</i>	<i>Triunfo del Real Oviedo 2-1 sobre el Cádiz.</i>	<i>El Numancia ganó en casa 3-0 el encuentro celebrado este sábado en el</i>	<i>El Nàstic cada vez tiene más complicado salvarse.</i>

	<i>celebrado este viernes en La Rosaleda.</i>	<i>Extremadura UD.</i>		<i>Nuevo Los Pajaritos.</i>	
Background	<i>El Málaga venía de empatar su último partido mientras que los visitantes perdieron el suyo.</i>	<i>El Extremadura UD venía de empatar su último partido mientras que los visitantes perdieron el suyo.</i>	<i>Los locales venían de perder su último partido, mientras que los visitantes venían de conseguir 6 puntos de los últimos 15 posibles.</i>	<i>El Numancia venía de empatar su último partido mientras que los visitantes ganaron el suyo</i>	<i>El conjunto tarraconense cayó por 1-0 ante el Rayo Majadahonda por culpa de un gran tanto de Luso en el tramo inicial de la primera parte.</i>
Classification	<i>Con este marcador, el conjunto malagueño es segundo tras la finalización del encuentro, mientras que el Almería es décimo.</i>	<i>Con este buen resultado el Real Sporting es décimo a la conclusión del partido, mientras que el Extremadura UD es decimonoveno.</i>	<i>Con esta derrota el Cádiz se sitúa noveno a la finalización del duelo, mientras que el Real Oviedo es octavo.</i>	<i>Con este marcador, el conjunto soriano es decimosegundo, mientras que el Lugo</i>	<i>Los majarriegos respiran mientras que los granas se hunden. Empezaron más incisivos los madrileños con dos intentos de Benito. El primero lo detuvo el guardameta y el segundo, pasó rozando el palo.</i>

Table 3. *Lead comparative: approach, gender and structure.* Prepared by authors.

From the study of the news, common information is obtained, without major differences in texts written by journalists and algorithms:

- INTERACTIVITY. There is not. These are discursive information without interactive resources.
- ENRICHED TEXT. Not observed. There is no links in the news in the analysed period.
- GRAPHIC RESOURCES. The text is headed with an illustration made with a picture of a stadium and a superimposed image including the names and shields of the teams, as well as the result. Sometimes, a video with the most interesting plays is offered. The illustration is dynamic and converted into advertising (micro-videos and loop ads (bets) with an option to close it and come back to the static image of the stadium with the result.
- PARA-LINGUISTIC ELEMENTS. There are not examples on the use of intertitles, but the bold type is used to emphasize the names of teams, players with highlighted actions, and stadiums.
- LOCATION. There is no one dating line. General references to the place of the match are made in the text.
- FREQUENCY. There are no relevant data because it is marked by the pace of the event, the competition journey and each of the matches. It is observed that it is not an immediate publication and it is deduced that texts created with algorithms are updated when there are

complete results of all matches are available, as they could affect the global classification, which is one of the parts of the team.

- ERRORS AND MISTAKES. No repetitions have been found. Information is updated, but no cases of correction of wrong information have been found.

Artificial journalism vs Human journalism		
Informative text (news)		
Headline	Subtitle	Lead
Empate, 1-1, entre Las Palmas y el Real Zaragoza	Las Palmas ha visto como se le escapan dos puntos en casa frente al Real Zaragoza.	Las Palmas y el Real Zaragoza empataron a uno en el partido disputado este lunes en el Gran Canaria. Antes de este partido, los locales habían conseguido 6 puntos de 15 posibles, mientras que los visitantes venían de ganar su último partido.
El Málaga y el Almería empataron a uno	El Málaga y el Almería empataron en el encuentro celebrado en La Rosaleda y se reparten los puntos.	El Málaga y el Almería empataron a uno en el partido celebrado este viernes en La Rosaleda. El Málaga venía de empatar su último partido mientras que los visitantes perdieron el suyo. Con este marcador, el conjunto malagueño es segundo tras la finalización del encuentro, mientras que el Almería es décimo.
El Deportivo y el Tenerife sólo sumaron un punto (0-0)	El Deportivo y el Tenerife empataron en el duelo disputado en el Municipal Riazor y se reparten los puntos.	El Deportivo y el Tenerife acabaron firmando las tablas con un 0-0 en el partido celebrado este sábado en el Municipal Riazor. Antes de este partido, los locales habían conseguido 7 puntos de 15 posibles, mientras que los visitantes venían de empatar su último partido. Con este resultado, el equipo coruñés se sitúa tercero, mientras que por su parte el Tenerife es decimocuarto a la conclusión del encuentro.
El Extremadura UD cae derrotado frente al Real Sporting (0-3)	El Real Sporting consigue tres puntos en casa del Extremadura UD y logra su octava victoria en esta edición de la Segunda División	El pasado domingo el Real Sporting ganó fuera de casa 0-3 ante el Extremadura UD. El Extremadura UD venía de empatar su último partido mientras que los visitantes perdieron el suyo. Con este buen resultado el Real Sporting es décimo a la conclusión del partido, mientras que el Extremadura UD es decimonoveno.
El Albacete derrotó al Córdoba por 1-3	El Albacete vence en el Municipal Nuevo Arcángel 1-3.	El pasado sábado el Albacete ganó fuera de casa 1-3 frente al Córdoba. Con este buen resultado el Albacete es cuarto, mientras que el Córdoba es vigesimoprimeros a la conclusión del partido.
Los tres puntos se quedaron en casa: Osasuna 1-0 Granada	Osasuna ha sumado tres puntos con una victoria en casa ante el Granada.	Triunfo de Osasuna 1-0 sobre el Granada. Antes de este partido, los locales habían conseguido 12 puntos de 15 posibles, mientras que los visitantes venían de empatar su último partido. Con esta derrota el Granada se sitúa primero a la finalización del partido, mientras que Osasuna es tercero.

El Real Oviedo derrotó al Cádiz por 2-1	El Real Oviedo consiguió un valioso triunfo como local ante el Cádiz por 2-1.	Triunfo del Real Oviedo 2-1 sobre el Cádiz. Los locales venían de perder su último partido, mientras que los visitantes venían de conseguir 6 puntos de los últimos 15 posibles. Con esta derrota el Cádiz se sitúa noveno a la finalización del duelo, mientras que el Real Oviedo es octavo.
El Mallorca venció como local al Alcorcón	El Mallorca consiguió el triunfo como local frente al Alcorcón por 2-0.	Triunfo del Mallorca 2-0 sobre el Alcorcón. El Mallorca venía de empatar su último partido mientras que los visitantes ganaron el suyo. Con esta derrota el Alcorcón se sitúa sexto a la finalización del encuentro, mientras que el Mallorca es séptimo.
El Numancia venció en su estadio al Lugo	El Numancia ha sumado tres puntos con una victoria como local frente al Lugo.	El Numancia ganó en casa 3-0 el encuentro celebrado este sábado en el Nuevo Los Pajaritos. El Numancia venía de empatar su último partido mientras que los visitantes ganaron el suyo. Con este marcador, el conjunto soriano es decimosegundo, mientras que el Lugo es decimoquinto tras la finalización del encuentro.
Interpretative / evaluative text (chronicle)		
Headline	Subtitle	Lead
Enésimo tren que el Nàstic deja escapar	Los de Enrique Martín cayeron por 1-0 ante el Rayo Majadahonda, rival directo en la zona baja / Fali volvió a ser expulsado, esta vez por doble amarilla.	El Nàstic cada vez tiene más complicado salvarse. El conjunto tarraconense cayó por 1-0 ante el Rayo Majadahonda por culpa de un gran tanto de Luso en el tramo inicial de la primera parte. Los majarriegos respiran mientras que los granas se hunden.
Revolución del Nàstic para dejar el farolillo rojo	Tras un final de mercado movido, los grana afrontan un partido vital por la permanencia	El Cerro del Espino acoge mañana un auténtico duelo por la permanencia. El Nàstic, actual farolillo rojo de la división de plata, se encuentra a sólo seis puntos de su rival, el Rayo Majadahonda que marca la línea de la salvación. Decisivo especialmente será el encuentro para los grana que ocupan el farolillo rojo de la división de plata, aunque a solo seis puntos de los ‘majarriegos’. “Es evidente que el partido de mañana es muy importante [...] redirigir la situación”, explicó Enrique Martín, entrenador del Nàstic, en la previa del encuentro.
	Manu del Moral, una de las bajas, volverá a enfrentarse a sus compañeros.	

Table 4. Comparative of news prepared with algorithms and journalists. Prepared by authors.

8. Conclusions

The automation of journalism is being installed in organizations, in organizational relations with the media, in the relations of sources with their journalists, in the way journalists connect with newsrooms, in the stage and place of work in mobility, in the variety of platforms and products, in the emergence of multimedia contents, in the ability of dialogue with audiences to meet their preferences, in the ability to broadcast news and fake news, and in the credibility of the platform as the true *fake check*.

New profiles and roles are under construction, but it is obvious that the cognitive work of journalists is the distinguishing element because it is not subject to standardized and mechanical procedures, as it is the case of routine processes. Studies on automation and products generated by algorithms focus on creating “table news”, that is, multimedia texts and stories based on the interpretation and explanation of data and statements. Algorithms have not yet reached other more complex genres nor informative roles such as street journalism. The first phase is information automation, not interpretive robotisation. And it is based on already-captured data, not on the meaning of data that can be extracted from the interpretation of the context not captured in documentary bases.

The role of professions varies with automation, and journalism is no stranger to those changes. Co-participative journalism, because co-creation of contents defines users’ behaviour on the Internet. News are changing, machines not only write, but update and change pieces of news in almost real time. Newsrooms start to be governed by systems of results measurement traditionally associated with journalism but also used as metrics of online activities: engagement and CTR are in engines of the main media to establish the most consumed pieces and those which generate less bounce rate and more comments with the clickbait as an accelerator of immediacy and antagonist of rigor and verification.

Artificial journalism is on the road and is characterised:

-Displacement of the control shaft. The interest now lies in controlling the fact (pseudo-event) and its story. It will lead to control of databases and facts as a way to condition the story of the machine and journalist, respectively.

-Improvement of AI, which learns as it acts. It is more and more close not only to narrate with a template, but to create the story from data, incorporating not only descriptive elements derived from the combination of data from the machine. Synthetizing voices and fragmenting audios and videos from press conferences by topic is already possible. Event to immediately orient every fragment to the public according to their interests. All languages are automatable. Possibly, all journalist genres, too.

-Changes in infrastructures. Computers without keyboard and mouse and attention to custom elements from online marketing applied to the news. In an increasing virtual world, newsrooms tend to be it too. Newsrooms with big tracking screens and computers without keyboard that work with voice are a close reality. Product segmentation and, therefore, its diversification to bring it to audience preferences, too.

-Need of reinforcing media trust. Effort to reach a brand value as a reference of positive reputation associated to a veracity or trust indicator against fake news, besides verification apps and sites. This works at the intellectual level, as at the affecting level, trust will be maintained in topics provided by acquaintances, which is why professional and personal relations of journalists with their audiences is on the rise.

-Cost reduction. The algorithm is active 24 hours every day, without labour legislation as regards length of working time and rest days. Return on investment does not stop, which will have an impact on employment.

-Impact on production routines and journalists’ behaviour in agenda-setting. An increasingly participatory professional is required, as he will promote the cognitive of his participation in the newsmaking.

-Innovation and originality. Creativity is reinforced as a professional value to differentiate and move away from standards reproducible by the algorithm and the machine, which indeed are predictable.

-It is necessary, in line with roboethics, an adjustment in deontology and ethics for informative texts created by algorithms, which are included in the media narrative together with journalists' texts, without any differentiation for the reader.

The comparative of computer generated texts and texts written by humans offers differences in approach and journalistic genre, but there are great variations as regards structure and writing. Artificial journalism is based on the study of behaviours of journalists and their informative proposals in order to identify replicable standards through algorithms. It is not unreasonable to think that the damping of the impact of automation on the profession lies on adopting a mimetic behaviour, but the other way around: analysing the process and products algorithmically-developed to create alternatives based on non-imitable proposals.

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