



Algorithms and bots applied to journalism. The case of Narrativa Inteligencia Artificial: structure, production and informative quality

Algoritmos y bots aplicados al periodismo. El caso de Narrativa Inteligencia Artificial: estructura, producción y calidad informativa



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Abstract:

This research analyses the organization, work processes and quality of the information produced by Narrativa Inteligencia Artificial, the only company in Spain that writes journalistic texts using the software known as Gabriele for distribution to various media. The study was conducted over a six month period

Resumen:

Esta investigación analiza la organización, los procesos de trabajo y la calidad de las noticias elaboradas por Narrativa Inteligencia Artificial, que es la única empresa del país que redacta textos periodísticos a través de un software, Gabriele, para distribuirlos a diferentes medios de comunicación. La investigación se ha desa-

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using in-depth, semi-structured interviews with four company professionals with complementary profiles, as well as participant observation during the process of creating an automated news item, and an online questionnaire filled out by 145 journalists (N=145) to assess the quality of the texts produced. The results show that the start-up company fulfils the demands of different sectors such as communication media, and has been increasing the productivity of its content, although it still does not generate complex texts, as this is one of many human qualities that robots continue to lack.

Keywords:

Artificial intelligence, Algorithmic journalism, Automated journalism, Production, Informative quality.

rrollado a lo largo de seis meses, mediante entrevistas semiestructuradas en profundidad a cuatro profesionales de la compañía con perfiles complementarios, observación participante durante el proceso de creación de una noticia automatizada y un cuestionario online cumplimentado por 145 periodistas (N=145) para valorar la calidad de los textos que produce. Los resultados muestran que la startup cubre las demandas de diferentes sectores, como los medios de comunicación, incrementando la productividad de contenidos, aunque todavía no genera textos complejos, una cualidad humana de entre las muchas de las que adolecen aún los robots.

Palabras clave:

Inteligencia Artificial, Periodismo algorítmico, Periodismo automatizado, Producción, Calidad informativa.

1. Introducción

Artificial Intelligence (henceforth AI) occupies a place in newsrooms dominated by people (Túñez; Toural; Cacheiro, 2018; Vázquez; Codina, 2018), as it generates greater productivity and efficiency in content production (Papadimitriou, 2016). It involves computer systems fed by journalists using data and algorithms to automatically generate comprehensible news for the audience from a previously programmed structure and formula (Barrat, 2013; Bunz, 2010). Consequently, its use has affected the routines of news professionals, mechanizing their search, classification and information processing functions (Lemeshtrich, 2018; Lindén, 2017). This trend is already taking place in Anglo-Saxon countries, where it is called robojournalism (Burrell, 2016; Carlson, 2015; Fernández, 2018; Lemeshtrich, 2018; Lee; Kim, 1998; Matsumoto et al, 2007; Van Dalen, 2012), although Bercovici (2010) prefers to call it “algorithmic journalism”; Clerwall (2014), Karlsen and Stavelin (2014) speak of “computational journalism”, and Caswell and Dörr (2018) talk about “automated journalism”. In Spain, Salaverría (2014) has named it “high-tech journalism”. The origins of AI go back to the advances made by Alan Turing in message decoding during World War II (Russell & Norvig, 2003). The term as such was first used in 1950, but it was not until the 1980s that research began to grow by solving algebraic equations and analysing text in different languages (Sancho Caparrini, 2018; Van der Kaa and Krahmer, 2014). Podolny (2015) associates its decisive expansion with the increasing demand for news from the information society in the digital age, which insists on content with an appetite that humans can no longer satisfy. Coddington (2015) and Van Dalen (2012) explain that the journalistic profession is becoming ever more deeply involved in the trend toward commercialization, and is being more heavily based on business logic. Therefore, the automation of tasks in journalism is adjusted to the predisposition to obtain higher profit margins and lower production costs.

However, it was not until the global economic recovery took hold in recent years that investment in this field has increased (Salazar, 2018). As a result, more and more media are betting on this emerging technology that handles big data and draws conclusions with extreme speed and precision in its results (Kim et al., 2007). In any case, this trend will continue in the coming years as pointed out in the latest report by the Reuters Institute entitled, *Journalism, Media, and Technology Trends and Predictions* (Newman, 2018). Eudes (2014) has written that this is the beginning of a great adventure, as automated

writing will soon show what it can really do, especially when it merges with other technological advances in journalistic writing and production.

The newspaper industry is aware that it must adapt to changing times and apply these techniques to traditional methods of generating news (Hansen et al., 2017). AI provides an encouraging scenario for innovative quality journalism (Fernández Barrero, 2018), which will allow journalists to move away from tasks that are more repetitive and routine and develop ones that are more creative and add value to journalistic work (Bunz, 2010; Ford, 2013; Graefe, 2016). In this context, recent investigations have analysed automated news writing and its impact on news production (Túñez, Parada, Toural, 2019), as well as the quality of automated news (Sandoval Martín, et al., 2019). Others show that the audience is not able to differentiate between texts produced by journalists and those produced through AI (Napoli, 2012; Van Dalen, 2012). For Silverman (2013), AI improves the quality and accuracy of journalism since its use promotes real time verification, allows for rapid identification of errors, provides instantaneous generation of timelines with factual data, detects plagiarism and manipulation of texts, and efficiently gathers a significant number of sources.

However, it should not be forgotten that there are various risks involved in its use, especially from the point of view of employment, business and the quality of information (Murcia; Ufarte, 2019). Another challenge is the development of AI proposals that not only replace the mechanical or operative part of the data control process and its objective value, but also succeed in transferring the cognitive part of journalistic work to the machine (Túñez; Toural, 2018). However, whether its use is more or less ethical does not depend on the scientific discipline developed over the years, but rather on the use made of it. For Sancho Caparrini (2018), its use is certain to change radically the way we face and solve specific problems, and this process has already begun, according to this researcher.

In this context of change, Cid (2017) and Oremus (2014) state that while this technology may be an excuse to replace editors and result in a crisis of unemployment just when the profession is starting to be resuscitated after a deep economic crisis (APM, 2018), the cause should not be sought in automatic writing systems, but in a business model shaken by the transfer of readers and advertisers from print to digital formats.

Whittaker (2018) criticizes the situation in which the growing weight of technology in information businesses has increased the value of business decisions to the detriment of journalistic issues. These systems need the help of humans to learn, so an analysis of their own functioning and the value of information is necessary. Therefore, there is no real danger of the profession becoming extinct, but we might instead see a process of change and adjustment to which machines are incorporated as proactive players, and in which journalists must emphasize their personal contribution, the cognitive part of news production (Cerezo, 2018; Renó, 2018; Salaverría, 2016; Túñez; Toural, 2018).

The objectives of the present investigation are as follows: to analyse the structure and organization chart of the startup company called *Narrativa Inteligencia Artificial*, as well as to study its production processes and the quality of the journalistic texts it produces. The work uses both a quantitative and qualitative methodology and is based on the following hypotheses:

H1. The company not only pursues individual profit for its founders. Through the search for a business model that helps them generate and achieve value, they can place their attention on the demands of different sectors, such as the media, that see certain needs covered

H2. AI increases journalistic productivity, since the editor delegates documentation and analysis tasks to the software, which indexes data from pre-set templates and generates informative messages in a systemized, precise, and fast way.

H3. AI is still unable to generate texts of a complex or unpredictable nature, which is a human quality that robots continue to lack, among numerous others. This emerging technology is used for simple information that does not require much analysis, and is mainly fed with statistical data such as those related to sports and finance.

An exploratory approach using a bibliographic review made it possible to establish that this new initiative is in the process of conformation. This first work aims to carry out an examination with a first in-depth case study. In the following paragraphs the scientific literature is gathered in order to understand the context, the methodology is presented, and the results obtained from this research are explained.

1.1. World map of media and companies

The limitations of automatic writing have not deterred the media from wagering on its experimentation. A report by Harvard University's Nieman Lab (Lecompte, 2015) warned of the progressive application of automated tasks with robots and algorithms in an increasing number of newsrooms in order to expand coverage, engage audiences, and respond quickly to breaking news.

The pioneer in using AI was the Los Angeles Times, which in March of 2014 published an article about an earthquake produced by Quakebot software, an algorithm created by programmer Ken Schwencke that uses data from the United States Geological Survey to write texts about seismic movements written from a previously created template. The initiative had a worldwide impact and motivated other media to engage in similar endeavours.

Thus, in the United States, the Associated Press agency has been using the Wordsmith tool from Automate Insights since 2014 to generate news articles about the quarterly earnings reports of approximately 3,700 companies (Dörr, 2016; Lichterman, 2017). In the same way, The Washington Post has been using Heliograf since 2016, which automates large-scale content for sports and finance. Similarly, The New York Times produces sports news created by mathematical algorithms that assess the decisions of coaches, and Forbes magazine has been working since 2016 with Narrative Science, a kind of virtual journalist who writes about economic and sports matters. For its part, the digital newspaper Quartz develops conversational robots and AI in its Quartz Bot Studio to help journalists, and the agency ProPublica disseminates analyses of the quality of American education (Opportunity gap). The Big Ten Television Network also uses AI to publish sports and financial information, as well as smaller media such as Local Labs, Hoodline and Hereford Times, which have joined this trend for the coverage of local services and events as well (Lindén, 2017; Sandle, 2018). Reuters has also been using robots or advanced automatic news writing software since 2016 to provide information with summary leads on the results of sports competitions and also to generate data visualizations on various topics.

In the city of Guangzhou in China, the Southern Metropolis Daily has experimented with Xiao Nan, a robot capable of writing summary leads (Martín, 2017). Furthermore, the South China Morning Post manages content and strategy with data obtained from the behaviour of its readers, and the news agency Xinhua has created the humanoid robot Jia Jia, which is capable of conducting interviews in English. In Japan, The Shinano Mainichi Shimbun uses an automated

solution to summarize news instantly. In the same way, data scientists in Latin America are working on the first robot-journalist to report on legislative bills (Monnerat, 2018). One of the pioneers in Europe was The Guardian, which in 2010 was already working with two sports news automation projects to obtain game statistics as well as historical information about teams and players. In addition, the daily newspaper combined this data with pre-set phrases and connectors to compose stories (Bunz, 2010).

A year later, it launched an app that automated the search for current news through Twitter (González, 2011), and in 2014 it did the same with Guarbot, a program that writes financial information using complex data, preventing journalists from doing the job (Gani; Haddou, 2014). That same year, the news company even published a free monthly newspaper in paper format with an American edition, and then British. The selection of topics was done by AI systems. The BBC News Lab already works with SALCO (Semi-Automated Local Content) software to cover local news, and The Telegraph has developed its own bot known as Roboblogger, which allows it to publish an indeterminate number of views from the data generated at each sporting event that is covered live on the web. Moreover, the UK Press Association has developed RADAR, a system that allows local stories to be written for the media in an automated way thanks to the information they collect from open data sources in governmental departments as well as from regional and local authorities.

In Germany, Der spiegel, Neue Osnabrücker Zeitung, Weser-kurier, Radio Hamburg Fussifreunde, and Fupa.net (formerly Fubanews), also use automation to write sports news, as well as Handelsblatt press, which uses it for economic texts. The Berliner Morgenpost also uses AI to report on particulate pollution in Berlin.

In France, Le Monde used AI to generate articles during the March 2015 elections (Sánchez; Sánchez, 2017), and the Swedish daily Svenska Dagbladet uses it to create customised home pages of its website from an algorithm that utilizes only two datum provided by the journalist: a “news” value (between 1 and 5), and a longevity parameter.

The rest is done by the machine, which places each news item according to various parameters, such as clicks on different news, length of stay, or preferences shown by each reader in previous visits (Stern, 2017). Similarly, several agencies admit transmitting content generated by web robots, but they do so without specifying the subject matter.

These include the following: DPA (Germany); ANP (Netherlands); STT (Finland); AFP (France); APA (Austria); Ritzau (Denmark); Lusa (Portugal); NTB (Norway); and TT (Sweden).

In Spain, some delegations of *Agencia Efe* also work with small automated data processing systems (Fanta, 2017), as well as *El País*, which in collaboration with Google applies AI to managing the comments of its digital readers in order to raise the quality of discussion and encourage conversation on the newspaper’s platforms. This media also created a bot on Facebook Messenger to provide information about the French presidential elections in 2017. This was in addition to the one it already had for general news, with the latter having more than 10,000 subscribers (Southern, 2017).

In 2017, *Vocento MediaLab* launched the “Medusa” project (InfoPlayas and InfoEsquí), which experiments with journalism-robot models to automatically generate content from some 800 Spanish beaches and all the ski resorts in Spain, Andorra and the French Pyrenees. *El Confidencial* has created Ana Futbot, a bot developed by El Confidencial’s laboratory that is already publishing automatic chronicles of Second Division B soccer matches. At the same time, Politibot stands out as well. This program was born as a Telegram bot to cover the Spanish Presidential elections on June 26, 2016.

This trend toward this new way of writing journalistic texts is also being carried out parallel to the media. In this regard, there are now international companies offering automated news services. In Germany, 2txt, Aexea, AX Semantics, Retresco, Text-on and Textomatic stand out. In China, it is Tencent; and in the United States, Automated Insights, Bloomberg, Linguastat, and Narrative. France has Labsense and Syllabs; Israel has Articoolo; United Kingdom has Arria, and Sweden has United Robots. In Spain, one company that stands out is *Prodigioso Volcán*, which collaborates with Software Intelygenz to develop infographics and visual images through machine-learning comprehension processes. Another is the startup company Narrativa Inteligencia Artificial, which together with the University of Alcalá de Henares has created Gabriele, a software that writes approximately 20,000 articles weekly in real time for the news media. It is the only company in Spain that provides AI-generated news to different media such as Sport, *20 Minutos*, *El Periódico*, *El Confidencial*, *El Español*, *El Independiente*, *El Heraldo* and *La Información*. However, its structure and organization chart, production processes and the quality of the texts it generates are unknown, so the object of this research is to respond to this unknown factor. It also works with some international companies such as The Social Audience, Property Finder, Intigral, Noon, and MSN (the collection of internet services offered by Microsoft). Consequently, the study of this entity can provide a more global vision.

2. Methodology

Design of the methodology for this research is based on a systematic review of the scientific literature, which is part of the secondary source research (Codina, 2017), and has allowed us to gain knowledge regarding the main contributions to the state of the question (Ramírez-Montoya & García-Peñalvo, 2018)

Furthermore, in order to carry out this research, the methodological triangulation of qualitative and quantitative techniques was chosen (Gaitán; Piñuel, 1998), which as Soler and Enríquez (2012) have pointed out, basically consists of contrasting information from different sources in order to obtain a sufficient contextualisation of the phenomena studied. First, a semi-structured in-depth interview was designed to address the most relevant issues regarding the object of study.

Four members of the company with complementary profiles were interviewed: David Llorente, founder of the company; Javier García; engineer in artificial intelligence; Alberto Moratilla; lead architect; and David Martínez de Lecea, director of operations. The interviews were conducted between January and May of 2019 and contained a series of questions related to the technical architecture of the project, the number of texts it produces weekly, the income it generates, and its value proposition, among other issues. Secondly, a participant observation was made during the process of creating an automated news item on unemployment in Spain in order to find out what role the journalist plays in the process. Marshall and Rossman (1989) define this qualitative technique as the systematic description of events, behaviour, and artifacts, the result of which must be a “written photograph” of the situation studied, according to Erlandson et al. (1993). This has been achieved using direct observation, informal interviews, and detailed field notes, as proposed by DeWalt & DeWalt (2002). The objective was to understand the functioning of its software, called Gabriele, and to gather additional information on its working methodology. The participant observation method took place during the month of May, 2019.

Finally, an online questionnaire was distributed to 145 journalists (N=145) to assess the quality of two news items produced by Gabriele. The company provided this information and one of the items is related to Apple's quarterly results (Figure 1).

The other is related to the intention to vote in Spain in the general elections that took place on 26 June 2016 (Figure 2). The sample evaluated the texts without knowing their authorship.

With regard to the journalists' profiles, 57.25% are women and 42.75% are men. They are between 22 and 60 years old, although the majority are between 30 and 45 years of age (42.8%). Of the total sample, 40.69% worked in the press, 25.52% in press offices, 10.34% in radio and 11.04% in television. The remaining 12.41% work in digital media, magazines and publishing houses (Table 1). For the selection of this sample, a criterion of convenience based on our professional collaboration network has been used (Humanes and Roses, 2014).

Table 1. Distribution of the sample surveyed

Datasheet of the sample surveyed				
Media	Journalists			
	Men		Women	
Press	No.	23	No.	36
	%	15.86%	%	24.83%
	Sample: 59 journalists (40.69%)			
Press office	Men		Women	
	No.	16	No.	21
	%	11.03%	%	14.49%
Sample: 37 journalists (25.52%)				
Radio	Men		Women	
	No.	8	No.	7
	%	5.51%	%	4.83%
Sample: 15 journalists (10.34%)				
Television	Men		Women	
	No.	9	No.	7
	%	6.21%	%	4.83%
Sample: 16 journalists (11.04%)				
Digital media, magazines and publishers	Men		Women	
	No.	6	No.	12
	%	(4.14%)	%	(8.27%)
Sample: 18 journalists (12.41%)				
Total simple: 145 journalists (100%)				

Source: Created by the authors

In order to carry out the questionnaire, the proposals made by Núñez Ladevéze (1993), Alex Grijelmo (1997), Martínez Albertos (1992), and Emil Dovifat (1959), regarding the quality of the information were taken into account and which are related to grammar, syntax, coherence, language and the style used. Similarly, the approaches of McQuail (1992), Schatz & Schulz (1992), Pottker (2000), Picard (2004), and Arnold (2009), who recommend attention to six features, were analysed: a)

Diversity of views and sources; b) Information relevance; c) Accuracy of information regarding events; d) Comprehensibility for audiences; e) Impartiality to ensure neutral and balanced coverage; and f) Ethics, understood as respect for people's fundamental rights. However, it is assumed that the quality of journalistic texts has an objective characteristic -quantifiable data- as well as a subjective aspect, which depends on the perception of the public (Sánchez Tabernero, 2008), so there is no unity of criteria for its development (Romero, Casas, Torres, 2016).

According to Cabero and Llorente-Cejudo (2013), developing such texts consists of asking a series of people to make a judgement regarding an issue, or requesting their opinion on a specific aspect. As such, five evaluators participated. Their selection was carried out randomly on a case-by-case basis in an attempt to delve into both the academic and professional aspects in order to obtain an evaluation with high levels of reliability. The final questionnaire consisted of nine questions, most of them closed, while others had a value scale of 1 to 5 in which 1 corresponded to total disagreement and 5 to total agreement (Likert, 1932). Moreover, several open-ended questions were added with the intention of gathering the main arguments they used in placing a value on the informative quality of the texts produced by Gabriele. The data collection took place during the months of March, April and May of 2019, and the questions were related to syntax, consistency in the presentation of ideas, cohesion in writing, grammatical correctness, noticeability, accuracy of information regarding events, diversity of points of view, as well as the quality of sources, context and interpretation.

Figure 1. Text about Apple's quarterly results generated by Narrativa Inteligencia Artificial.



Source: Narrativa Inteligencia Artificial

“Text generated by Narrativa Alpha version 0.1

Finances. Quarterly results (Apple Inc.) Source: Apple.com

Apple reported quarterly sales of \$51.5 billion, an increase of 22.3% over the same quarter last year.

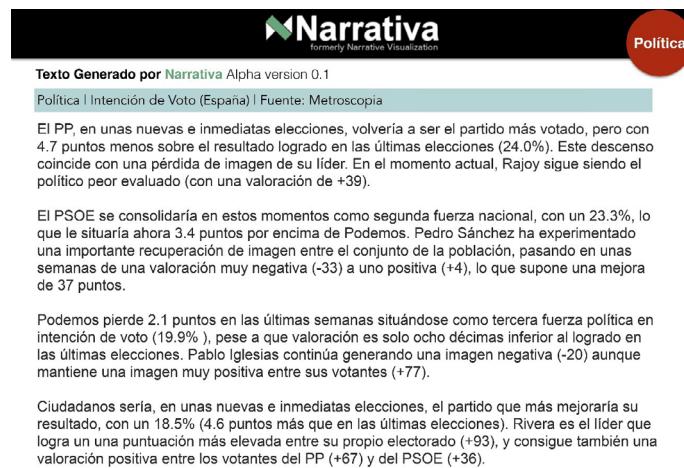
Quarterly net income of \$11.1 billion is equivalent to \$1.96 per share, which is 30.5% higher than the \$8.5 billion earned in the same period last year.

The company's gross income was 39.9%, compared to 38% in the same quarter of the previous fiscal year.

The results for the quarter boosted earnings per share by 38% and increased cash flow from operations by \$13.5 billion.

Fiscal year 2015 was the best year in Apple's history, with sales growing by 28% to nearly \$234 billion."

Figure 2. Text on the intention to vote in Spain, generated by Narrativa Inteligencia Artificial.



Source: Narrativa Inteligencia Artificial

"Text generated by Narrativa Alpha version 0.1

Politics. Voting Intention (Spain) Source: Metroscopia

If new elections were held immediately, the political party known as *Partido Popular* (PP) would again be the party to receive the most votes, but with 4.7 points less than the result achieved in the last elections (24%). This decline coincides with a loss of image of its leader, Mariano Rajoy, who at the moment retains the title as the worst rated politician (with a +39 score).

The party known as *PSOE* would currently become the second national force, with 23.3%, which would place it 3.4 points above the political party *Podemos*. Pedro Sanchez has experienced significant recovery of his image among the entire population, and in a matter of a few weeks has gone from a very negative opinion (-33) to one that is positive (+4), representing an improvement of 37 points.

Podemos has lost 2.1 points in the last few weeks, placing itself as the third political force in voting intention (19.9%), despite the fact that the score is only 8/10ths lower than that achieved in the last elections. Pablo Iglesias continues to generate a negative image (-20), although he maintains a very positive image among his own voters (+77).

If new elections were held immediately, *Ciudadanos* would be the party to improve its results the most with 18.5% (4.6 points more than in the last election). Rivera is the leader with the highest score among his own electorate (+93) and also has a positive opinion among voters of both the PP (+67) and PSOE (+36).”

Due to the characteristics of the sample, the results are not completely generalizable, an example of which is the fact that not all journalists in the country are represented. However, this does not invalidate the results, since the primary purpose of this study is not quantitative but qualitative. In other words, the number of information professionals is not as important as the arguments they use because these professionals were more directly involved in the object of study. It is worth recalling the words of researchers Rubio Romero and Perlado Lamo de Espinosa (2015), who indicated that a qualitative sample does not seek statistical representativeness, but rather structural, because what it seeks to understand is the different social meanings and relationships with the phenomenon under investigation, not the extrapolation of the data to the universe, as in the case of a quantitative sample.

3. Results

3.1 Structure and organization chart of *Narrativa Inteligencia Artificial*

The Spanish startup company was founded in the summer of 2015 and is legally established in the Civil Code as a Private Limited Company (Ltd.), specifically under the name of *Narrativa Inteligencia Artificial S.L.*

The team is composed entirely of engineers with more than 75 years of experience in total, among which the following stand out: David Llorente, company founder; David Martínez de Lecea, head of operations; Géneis Capunitan, vice-president of Marketing; Alberto Moratilla, software architect and Agile Software expert; and Javier García, AI engineer. Also participating are professors from the University of Alcalá de Henares, such as Eugenio Fernández, an AI expert. In addition, there is Antonio Moratilla, a computer scientist and expert in big data/software who collaborates with *Narrativa Inteligencia Artificial* through the Research Chair “Artificial Intelligence and Data to Text Generation”, which focuses on research and development of big data and AI techniques aimed at generating text narratives from data.

The company is headquartered in Estonia and has two other offices in Madrid and Dubai, where it carries out e-commerce projects and collaborates with the Government of the United Arab Emirates in generating reports based on official statistical data. David Llorente explains that the company was founded with the idea that technology can transform the world in a positive way. Gabriele’s proposed value lies in automating news in order to anticipate content, create trends, and meet customer demands in the global marketplace.

The company possesses highly advanced technology and has established an alliance with *EFE* for the joint development of news, which the agency then distributes directly to its clients. “This combination is unique in the world”, says the company founder.

The initial experiment produced around 40 journalistic texts per week, but the figure has increased to 20,000 articles per week in the current year of 2019. The subject matter is varied, but the sports and financial texts stand out the most. The

flexibility inherent in this start up is evident in the product diversification it offers, as Gabriele can be customized for a variety of companies and industries that deal with data overload. In this way, it provides services to the financial field, performing a comprehensive conversion of data into customized reports for specific audiences, with a natural language that is easy to understand. For example, Gabriele is able to create descriptions of the financial positions of Bankia clients so they can understand their accounting transactions and know how much they have saved or spent in a given period of time compared to other periods.

It also conducts optimized SEO descriptions in the e-commerce sector and generates property models from real estate data. This software tool also works in the health and telecommunication sectors where it identifies relevant issues and communicates findings in an easy to understand format.

In the media sector, it automatically generates news from the interpretation of statistical data. For the newspaper Sport, it writes articles for the First, Second and Third Divisions, King's Cup, Champions League and Europa League. Gabriele also covers European leagues in countries such as Italy, France, Germany and England, as well as the Saudi league. Moreover, in the coming months it will write about all of the Federated Leagues, from Benjamin to Youth. *El Independiente* and *El Periódico* also rely on this software to write financial news with topics related to currencies, commodities and Bitcoin. Other media that rely on the start-up are *20 Minutes*, *El Confidencial*, *El Español*, *El Heraldo*, *La Información*, and *MediaPro*, which obtain larger and faster content production at a more efficient cost, maintaining their commitment to a specialized public.

Globally, the company is currently conducting tests with the Associated Press to jointly write texts that the U.S. agency will then distribute directly to its clients. It has also collaborated with the German news agency DPA for three years and is currently about to complete a financing agreement of about one million euros with two German investment funds, which company managers are reluctant to disclose until the deal is closed. In the same way, the startup also works for international companies such as The Social Audience, Property Finder, Intigral, Noon, and MSN, the latter of which is the collection of internet services offered by Microsoft.

The result of these collaborations has been better SEO positioning with original content, while the human staff has been able to focus on generating articles that are more complex. "Artificial intelligence helps us position ourselves better, make our business more sustainable, and cover news that wasn't covered before", explains David Martínez de Lecea, director of operations.

For its part, the company's income basically comes from the banks and governments with which it collaborates. However, the media are also one of its main sources of funding, as they pay a monthly subscription for the news they receive. This amount depends on each media and the number of texts, but varies between 3,000 and 4,000 euros per month for those companies that receive an average of 20,000 articles per week. In Spain, without sufficient support from the large media conglomerates, company managers are searching for new sources of income through the automatic generation of content for financial services, the healthcare sector, and e-commerce.

As for future projects, Narrativa Inteligencia Artificial will focus on servicing the finance industry and providing services to governments. "We will continue to work in the mass media industry, but it will not be our main focus" Llorente says.

3.2. Production processes

The company's AI engineer, Javier García, explains that "the program works like a human mind: it captures data, analyses them along with other examples, and generates the news". In practice, however, the method of working to generate content through Gabriele is more complex.

In the participant observation carried out within the framework of this research, the way in which a news story about unemployment in Spain is produced was analysed. The process is divided into three phases:

The first is called "definition of the news design" and consists of the continuous input of data into the program. At this stage, different chronicles, reports and news, among other journalistic genres about unemployment in the country are introduced. These publications serve as a template for the system to automatically detect patterns, items, key words to be dealt with, the context, and linguistic structure. For this reason, these texts have been characterised as having a simple composition, lacking comprehensive interpretation, and a clear linguistic structure. "The aim is to create a kind of library, or narrative archive, that serves as a model or guide for later texts", explains Llorente. On the other hand, the company's lead software architect Alberto Moratilla makes it clear that as more examples are provided, the quality of the news created by the software improves. In sports, for example, approximately 10,000 pieces of information are generally used, while in financial matters the figure increases to about 50,000. Currently, the program has compiled around 10 million journalistic texts, equivalent to approximately 40 gigabytes. These examples are selected beforehand by a team of journalists, the number of whose oscillates, but the usual number is two. This is the only stage where information professionals are involved in the production process. This is the phase with the greatest amount of work a priori, but once it is under way, the system itself learns and improves.

The second phase is called "machine learning comprehension", based on the downloading and further processing of the data entered in the previous stage. The system has taken the selected, relevant information from the knowledge base and combined it with the template format of the library, extracting the most pertinent data. In addition, two algorithms come into play in this process: variability and similarity. The first has created possible initial structures from different combinations and has detected the most relevant content patterns. In the case of the news on unemployment, these were as follows: the long-term unemployment rate; the number of unemployed people registered at Public Employment Offices; the number of people compared to the previous month; job creation registered by Autonomous Regions; and finally, the number of workers registered with Social Security, among others. On the other hand, the second algorithm limits itself to detecting similarities between texts and indicating which articles are similar. If two very similar news items have been created, the program rewrites them so that each client (media) has different information. At this stage, Gabriele can also customize the language and tone, according to the editorial style of each media, ensuring consistency with the rest of the content. "Currently, the texts generated automatically by our software include English and Spanish, and we are the only company in the world that includes Arabic", states García.

Once these patterns have been established, the third phase begins, called "matching", where we work with a CSV file, which is a type of text document that stores data in the form of columns and tables. This file forms a graph that merges and indexes the data extracted in real time with the narratives already existing in the system. In the case of the news about unemployment, the program has taken the unemployment data recorded in the month of April, compared them with the

texts of that same month written in previous years (that were introduced in the first phase), combined both elements, and created the news. The result is a text with a specific topic, natural language, and easy to understand, which has been represented in an XML or JSON file. This document was sent to customers through the API system, which allows the media to access all the information available in the company's database via URL. In addition, all informative texts created by Gabriele are accompanied by an image, which is also created through algorithms. "Our program allows for greater content production, at more effective costs, which leads to greater commitment toward niche audiences and an increase in productivity of the editorial staff, who can focus on more complex stories", as Martínez de Lecea emphasizes. At the same time, Moratilla argues that the system is pushing the limits of what was thought possible, both in terms of production quality and its wide variety of potential uses.

All the content generated is published on the website of the different media with which the startup collaborates, yet at no time does the media reveal to the reader the authorship of the news. In other words, they publish the text with the signature of the newspaper in question without alluding to the automatic generation techniques used by the startup company. For that reason, *Narrativa Inteligencia Artificial* recommends that the media indicate the fact that the content has been created through an algorithm and reveal the source of the data, as is already done in the United States.

3.3. Quality of the texts produced by Narrativa Inteligencia Artificial

Analysis of the journalistic quality of the texts generated by Gabriele as a result of the 145 journalists surveyed sends contradictory signals. On one hand, the sample places a positive value on the neutrality, veracity, syntax, brevity and coherence of the facts that are narrated, but considers that the originality, variety, style and rhythm are questionable, and therefore can be improved.

In the case of the news about Apple's quarterly results, 78.87% of the sample "fully agree" with the syntax used in the text and 62.15% believe that the consistency in the presentation of ideas is correct. With regard to cohesion in the wording, 51.87% believe it is adequate, while the remaining 48.13% think that it could be improved, since there is no uniformity in the representation of symbols (21.15%). The journalists also agree on the point of grammatical correctness: 40.87% "partially agree" that there is clarity in the ideas and expositive transparency, while 15.12% "totally agree". The remaining 44.01% are neither in agreement nor in disagreement. In terms of news coverage, 55.09% of those surveyed consider that the text is sufficiently current and important to be published in any media. In addition, 77.56% "totally agree" on the accuracy of the data that are narrated with regard to the news event since the software completely avoids words of broad meaning and uses precise terms. In the opposite way, the professionals gave a negative evaluation to other aspects related to the aesthetic features of the text. The figure of 92.18% criticise the fact that there is no diversity in points of view, and 83.21% think there should be a greater variety of narratives as well as a higher level of quality in information sources. In the same vein, 83.13% of the journalists who took part in this research believe the text lacks context and interpretation, which makes it superficial (29.51%), and they also think it is too restrained and concise (9.79%).

The news about the intention to vote in Spain in the general elections on 26 June 2016 show similar results. The figure of 63.56% of the sample surveyed "totally agree" with the order and relationship of the noun phrases in the information, and

59.39% maintain that the coherence between statements is adequate. In terms of cohesion, 53.81% also gave a positive rating to the way in which the different words, sentences and paragraphs of the text, both syntactic and lexical-semantic, are related and joined together. The figure of 52.17% of those surveyed “totally agree” with the appropriateness of the news item, because it is well written (29.34%) and respects spelling and grammar rules (22.83%), thanks mainly to the use of short sentences. Journalists also gave a positive evaluation (51.09%) to the criteria of newsworthiness and accuracy, despite the fact that the information relates to the intention to vote in Spain in the general elections of 26 June 2016. Along the same lines, 68.97% of the professionals say they are “in total agreement” with the accuracy of the data regarding the news facts and the impartiality, neutrality and honesty with regard to reality. However, 87.23% think there is no diversity of views, so the quality of the sources is questionable (77.56%), since their origin is not reflected.

Finally, the journalists consider that the context and interpretation can be improved: 79.64% think it lacks variety of expressiveness regarding the facts narrated, so the information is considered to be monotonous (28.20%), lacking in rhythm (25.30%), poor in vocabulary (15.17%), and improvable in style (10.97%).

4. Discussion and conclusions

The present research carried out has allowed us to consider the initial objective of analysing the structure and organization chart of Narrativa Inteligencia Artificial, as well as studying its production processes and the quality of the journalistic texts it produces. The company was founded in 2015 and is the only company in the country that generates automated texts for the media. Since its founding, the startup has not stopped customizing its services to generate and increase its value, nor has it ceased responding to the demands of different companies and industries that deal with data overload, such as those of the financial sector, e-commerce, real estate, healthcare and telecommunications. In the media field, for example, it generates automated news for various Spanish media companies such as El Confidencial, Sport, El Periódico, El Español, El Independiente, 20 Minutos, El Heraldo, La Información, and MediaPro. Furthermore, it collaborates in the international field with the Associated Press agency in the collaborative writing of texts (Hypothesis 1).

The product and formats used by Narrativa Inteligencia Artificial reflect the cultural and technological change that the media industry is currently undergoing (Pavlik, 2015).

The company is contributing to the revitalization of journalism with the search for new communicative formulas and business models. This shows a panorama that is radically different from the trends of the traditional company in recent years when it comes to having new information products on the market.

The startup’s software, Gabriele, increases journalistic productivity by automatically, accurately and quickly generating around 20,000 journalistic texts on specific topics per week by indexing data from preset templates (Hypothesis 2). Specifically, the content generated is based on computational learning, or machine learning, through the input of large amounts of data that serve as a basis for writing or creating content. This situation allows the writer to move away from repetitive, routine tasks and develop those that are more creative, and that add value to journalistic work. However, in the production process the presence of the journalist is necessary, especially when selecting writings samples of interest that will serve as a model for later information.

As for the texts produced by the software, they have a style, structure and composition not much different from a summary lead in journalism. In other words, this technology works best with simple information that requires a system of repetitive composition based on data. The information produced by Gabriele lacks diversity in points of view, quality of sources, context, and interpretation, as corroborated by the sample surveyed in this research (N=145). In the case of the news about Apple's quarterly results, 83.13% of the sample believe that the text lacks context and interpretation, and as a result it is superficial (29.51%), overly restrained, and too concise (9.79%), while in the news about the intention to vote in the general elections in Spain on 26 June 2016, 79.64% consider the text to be lacking in variety of expression with regard to the facts narrated, and as a consequence the information is monotonous (28.20%), lacking in rhythm (25.30%), poor in vocabulary (15.17%), and has an improvable style (10.97%). Hypothesis 3 is therefore confirmed, since AI is not yet capable of generating texts of a complex or unpredictable nature, which requires human qualities that are still lacking among robots, among many others. Moreover, this software cannot write its own opinion, invent things, or even contribute to forming an opinion. In other words, the component of closeness, of human psychology, so highly valued on many occasions in the journalistic world, is currently not foreseen as an ability that robots will have in the future (García, 2017). Under these circumstances, journalists must take advantage of their competitive edge and their ability to reason as humans. This is why Villoro (2017) requests that information professionals write in a way that is meticulous, reflective, and soothing. Writing also involves the conveyance of emotion. This is well known to journalists, whose stories emphasize observation as well as the ability to discern and express experiences, despite the fact that for years they have wanted to equate journalism with the rhetoric of objectivity and predominantly informative.

In line with these approaches, the theories of Cerezo (2018), Renó (2018), Salaverría (2016), and Túnnez and Toural (2018) are endorsed, which consider there is no real danger of the profession becoming extinct, but instead see a process of change and adjustment in which machines will be incorporated as proactive players, and in which journalists must emphasize their personal contribution, or in other words, the cognitive part of news creation. As a result, editors must stop seeing emerging technologies as enemies and start thinking of them as tools to make their job easier and better, as stated by Cosoy (2017), because AI helps in the automation and improvement of many of the processes that are currently being carried out manually (Salazar, 2018). In this context, Van Dalen (2012) places his bet on clearly defining the functions and roles of information professionals who cannot compete with some of the advantages offered by computer-generated automatic writing systems, such as low marginal costs, speed in writing articles, and the wide spectrum of events that can be covered. It is also necessary to address the need to prepare journalists for a changing environment in which technology determines transformation. This forces us to understand their proposals and peculiarities, but without neglecting journalistic foundations that have developed over time (López García, Rodríguez Vázquez, Pereira-Fariña, 2017). This research is not exhaustive regarding the issue studied; on the contrary, it reaffirms that the debate is open and evolving.

This study, despite corroborating the three initial hypotheses, has certain limitations and leaves open the possibility of future research. A broader sample would have made it possible to obtain more conditions that could have been extrapolated to the entire market in the same way that the inclusion of international initiatives could help to compare the development of these initiatives in Spain with those of other countries. This does not invalidate the results, however, since the primary purpose of this work was not quantitative, but qualitative. Finally, with regard to future research in this area, there is

substantial room for the development of similar studies aimed at understanding additional distinctive features and trends in the use of AI in journalistic production processes. Conducting similar investigations will result in greater knowledge of this practice and will serve to point out the value of research centres and investigators who support the study of AI in journalism.

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