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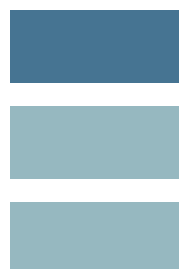
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Perception of the CERN/LHC:
Evidence from French Media Articles

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Abstract

CERN is advancing plans for the Future Circular Collider (FCC), a next-generation particle accelerator designed to push the boundaries of high-energy physics beyond what was possible using the Large Hadron Collider (LHC). As a scientific mega-project of unprecedented scale, the FCC requires substantial financial and scientific resources over a long time horizon, making sustained public support essential for its success. However, fostering favourable public perception is a complex challenge influenced by diverse factors, including the project's scientific foundations, potential benefits, and the broader social and political context. Media outlets play a pivotal role in this process by selecting, framing, and broadcasting information to the public. This role persists despite the pressures exerted on traditional journalism by the rise of social media.

This paper seeks to deepen our understanding of how large scientific projects are perceived in the media, using CERN and its LHC as a case study. Specifically, it examines how CERN and the LHC have been portrayed in French media from 2006 to 2024, focusing on the topics emphasised and the sentiment associated with this coverage. Two key research questions guide the analysis: (1) What are the main topics covered by French journalists regarding the LHC and CERN? (2) How has media perception of LHC and CERN evolved?

Using statistical and natural language processing techniques, I show that French media coverage of CERN and the LHC fluctuated cyclically, often influenced by major scientific milestones, such as the discovery of the Higgs boson, or negative incidents, such as terrorism allegations. Despite these fluctuations, French media coverage remained predominantly positive, showing no significant trend toward increased negativity or polarisation, as may be expected from comparisons with social media. These findings suggest that traditional French media may support fostering positive public perceptions of CERN and the LHC. The implications for research institutions' communication strategies are also discussed. For instance, the positive perceptions of CERN/LHC in French media constitute a favourable context for the transition towards new projects, such as the FCC.

Keywords: Media, articles, perception, science, society, journalism, framing, topic modelling, sentiment analysis, LHC, CERN, FCC

Contents

1. INTRODUCTION

In the last decades, many fields of science have relied on large-scale collaborations, supported by substantial funding and the use of advanced technologies to address complex scientific questions (Liyanage et al. 2024). This rise of "big science" has notably been documented in high-energy physics, for instance, with the development of CERN accelerators (e.g., LHC, FCC...). These big science projects require high levels of public support to be launched and sustained during their operation, owing to their financial cost and high visibility. This support (or lack of support) can notably be influenced by media coverage of science in general and specific projects in particular.

Journalists in traditional media (including print and online press) continue to play a significant role in science communication, even if the playing field has radically evolved since the development of the internet (Fahy and Nisbet 2011). Indeed, the general population still largely considers traditional media a trustworthy source of information. As of 2022, 39% of Europeans reported that the written press was among their most trusted sources of information, compared to only 14% for people, groups, or friends on social media (European Commission 2022). However, journalists are pressured when reporting on science and technology issues, which can have important implications for their coverage regarding topics, tone, and polarisation (Jamieson, Kahan, and Scheufele 2017b).

There is a notable gap in the scientific literature regarding media perceptions of large-scale scientific projects or infrastructures. While there is extensive research on public perceptions of science and technology (mostly using surveys), as well as the role of media in shaping these perceptions, the specific focus on how media portrays these projects in their content is very restricted at this stage. This can limit our understanding of how the media may influence perceptions, and how it can be considered by the scientific community.

In this paper, I carry out an analysis of the content of media articles dedicated to CERN/LHC, which is a highly visible "big science" endeavour. It also features high stakes in terms of public perceptions, given the ongoing effort to develop a new accelerator on CERN premises, namely the FCC. I focus on French media articles, given that the CERN is (partly) hosted in this country. Concretely, I will tackle two research questions (RQ):

- RQ 1. Which topics are discussed by French journalists in their coverage of the CERN/LHC?

- RQ 2. How does their perception of the CERN evolve, as proxied by the content of their articles?

Beyond obtaining insights on the specific case of the CERN/LHC, I thus contribute to the existing literature methodologically by providing a scalable approach to measure the perceptions expressed in the media about large-scale scientific projects, combining topic modelling and sentiment analysis. I also provide insights relevant to science policy by contributing to the adequate measure of the perception of "big science", complementing more widespread approaches that rely on surveys.

The rest of the working paper proceeds as follows. Section 2 briefly reviews existing literature on how science is portrayed in the media, with a specific focus on the case of large-scale scientific infrastructures/projects. Section 3 outlines the methods deployed in the paper. Section 4 describes the data and the statistical approaches to processing them step-by-step to make the procedure easily replicable to anyone in different scientific fields, infrastructures, or media samples. The results are presented in Section 5. Section 6 concludes with a discussion of policy implications, caveats, and suggestions for future research.

2. LITERATURE REVIEW

Media coverage, including (online) newspapers, television, and radio, historically played a role in shaping public perceptions of science, though its influence should not be overstated[1]. Indeed, existing evidence indicates that media coverage can act as a source of information for the wider public. However, how they receive it largely depends on individual, social, and contextual factors (e.g., Brossard and Nisbet 2009). Still, how scientific topics are framed, especially for controversies, can either enhance public understanding and favourable views or instead contribute to confusion and scepticism (Nisbet 2009).

Given its potential importance, considerable scientific literature has thus been developed regarding science's portrayal in the media. This literature has studied the topic from multiple angles, including media content but also diffusion channels, the role of various stakeholders (e.g., scientific institutions and scientists, pressure groups) and reception by the public (see, for instance, for a detailed overview Jamieson, Kahan, and Scheufele 2017, especially Part 5). As a consequence, several methods, both qualitative and quantitative, have been mobilised by researchers in this field (see, e.g., Oehmer-Pedrazzi et al., 2023).

In particular, the subfield of research focusing on the content of the media discussing scientific issues is of high interest to the present study. This literature analyses the framing, arguments, rhetoric/tone and other elements put forward by journalists in their coverage (Oehmer-Pedrazzi et al., 2023). These content-oriented studies can notably rely on techniques such as sentiment analysis or topic modelling (Puschmann and Scheffler 2016; Jacobi, Atteveldt, and Welbers 2018). This strand has expanded in recent years but remains unbalanced in terms of geographical and disciplinary diversity. Indeed, researchers have mostly focused on health or environmental sciences, neglecting physics and engineering (Schäfer 2012).

Regarding specific themes or angles, the existing studies on the content of media dedicated to science notably explored controversial or politically sensitive scientific topics. For instance, some studies tackled media coverage of scientific issues related to environmental science (e.g., climate change) (Rabitz, Telešienė, and Zolubienė 2021) or controversial technologies, such as fission nuclear power (Culley et al. 2010). Given the high political sensitivity of the topics explored in the literature, significant polarisation is often found in the results (e.g., highly negative, or positive content, mobilisation of specific interest groups). It aligns with the fact that science journalism is under pressure due to the development of social media and other transformations in journalism (Jamieson, Kahan, and Scheufele 2017b). It remains unclear if these findings could translate easily into other fields, such as more abstract fundamental research (e.g., particle physics).

Studies specifically investigating scientific projects or large-scale research infrastructures are scarcer. When performed, they often do not deal with the content of the media coverage but rather observe the perceptions of the public through surveys. For instance, a recent survey assessed public support for ITER's development, a large-scale experimental nuclear fusion reactor (Oltra et al. 2019). It implies that there is a lack of evidence on the perception of journalists on such projects, which can contribute to driving the perceptions of the wider public. More common is research on the media coverage of other types of infrastructures, such as civil engineering or transportation projects (e.g., Chowdhury and Alzarrad, 2023). The evidence on media coverage of research infrastructures / large scientific projects may be partially present in closed data within the communication units of these infrastructures or projects. This paper will thus contribute to bridging gaps in the literature:

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1 The role of media in shaping opinions is strongly nuanced by the critical capabilities of the audience. This situation was established by early works, such as Wright 1952

- Methodologically, it will apply text analytics/sentiment analysis to media content about large-scale scientific projects, a field that was, until then primarily analysed through surveys and other approaches. It can help to mitigate biases resulting from surveys (e.g., self-selection, acquiescence bias).

- It will contribute to discussions on science policy by bringing insights into the perception of journalists, which are instrumental in shaping wider public opinion.

- More specifically, it will discuss the case of CERN/LHC, a major research infrastructure in particle physics, an area until then understudied regarding its portrayal in the media.

3. METHODS

In order to tackle the research questions presented above, my approach will rely on combining two main techniques, namely topic modelling and sentiment analysis.

Topic modelling is a type of statistical modelling used to discover abstract themes, or "topics," in a collection of documents. It assumes that documents are mixtures of topics and topics are mixtures of words. Essentially, it helps to identify the recurring themes or hidden structures within large text datasets by clustering words that frequently appear together into topics. One of the most commonly used techniques for topic modelling is Latent Dirichlet Allocation (LDA). This approach is well adapted to manage large numbers of documents systematically, uncover changes in focus over time, and support further sentiment analysis. It was already used in the context of analysis of scientific topics, such as nuclear power (Jacobi, Atteveldt, and Welbers 2018).

Topic modelling was applied to data on French media articles (see the following section for a descriptive analysis of this data). I followed a standard approach to LDA analysis, implementing it using R packages (Gillings and Hardie, 2023). In particular, I processed the full text of articles (including titles, summaries, and full content when available), applying operations such as lowering case, removing punctuations, and stemming words. I also removed the stop words and infrequent words in the sample (less than five occurrences). I then applied a LDA model with k = 14 topics, based on a tuning phase ranging from 1 to 50 topics, under different metrics (CaoJuan 2009, Deveaud 2014, Arun 2010, Griffiths 2004). I analysed the obtained topics based on the most frequent words and the most representative articles for each topic. Lastly, I gave meaningful titles to each topic and regrouped them in more exhaustive categories when relevant, as recommended in the existing literature (Jacobi, Atteveldt, and Welbers 2018). It allowed a description of the content of each article by topic (i.e., the percentage of an article related to each topic).

I then applied sentiment analysis to the media articles (Robinson, 2024). I adopted a simple lexicon-based method for this analysis, using the NRC implementation to identify positive and negative words in English (Mohammad 2022). Stop words were removed from every article, and then positive and negative words were counted. A net value (count of positive minus count of negative words) was then computed. A corrected net value was created to adjust for the different lengths of the articles by dividing the previous result by the total number of words (including neutral ones). This process allowed the attribution of sentiment values for each article, with the possibility to compute yearly averages for the entire sample of articles over time.

This study's limitations include focusing on French media articles only (as discussed above). I also observe the perceptions of journalists themselves, not directly how they might influence the wider public. These elements may be resolved in subsequent future studies.

4. DATA

I constructed the data on media coverage related to the CERN in French media using primary sources. The scope of data collection consisted of major French newspapers between 2006 and 2024. The data collection was performed in March 2024. The exact list of newspapers was defined using data on circulation (ACPM 2024a; 2024b) and practical considerations on the accessibility of the content online. Each newspaper was searched either manually or automatically (e.g., using GallicaNgram for Le Figaro) for relevant articles using the keywords "CERN" and "LHC." Key variables collected included newspaper, title, publication date, summary, and full text if available. Content only includes evidence directly found freely on the newspapers' websites. Following this process, 702 articles were retrieved from 7 different newspapers (Les Echos, Le Figaro, Ouest France, La Croix, Libération, le Parisien, le Monde). Together, they account for a significant share of press coverage in France and are diverse in terms of political leaning and geographical specialisation. It should be noted that some newspapers were searched for relevant articles (e.g., l'Equipe), but none could be found, and they were thus not included in the final sample.

The completeness of the data was good, with at least part of the full text available for 664 out of the 702 articles (94.5% of the sample). All textual information (including title, summary, and full text when available) was consolidated into a unique variable to facilitate the analysis. The texts were then translated into English using the Google Translate machine translation tool.

As expected, the articles were not spread uniformly across time. In particular, a major peak of media interest occurred in 2012, linked to the discovery of the Higgs Boson and other CERN-related events (e.g., the Adlène Hicheur terrorism incident). The graph below outlines the cycles in media activity related to CERN.
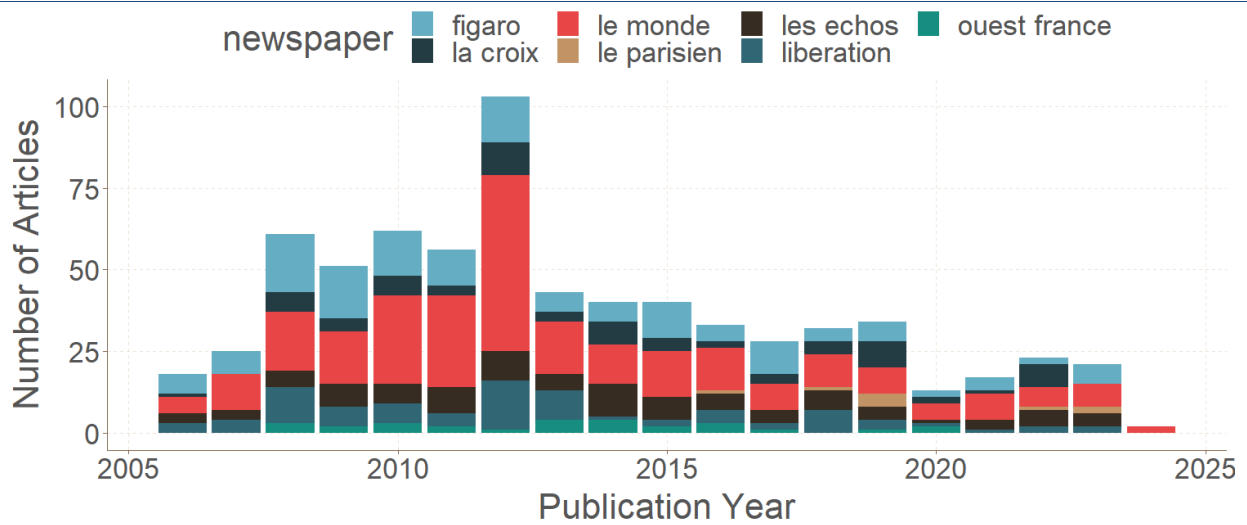
Figure 1. French media coverage of CERN/LHC
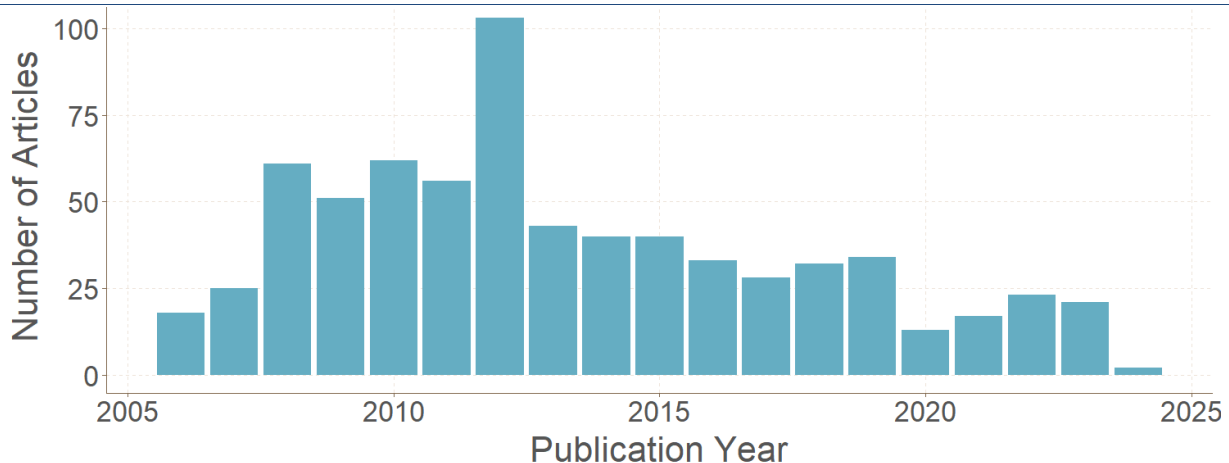
Source: Authors based on a sample of 702 articles published between 2006 and 2024 in 7 major French newspapers.
Note: Incomplete data for 2024 (extraction of content in March 2024).

This coverage was not split equally among all the newspapers. Indeed, major "newspapers of record" contributed to the highest coverage shares, with Le Monde representing 38% of the total, le Figaro 21%, Les Echos 14%, and Libération 12%. This split was fairly stable over time, as shown in the graph below.

Figure 2. Coverage of CERN/LHC by French newspaper

Source: Authors based on a sample of 702 articles published between 2006 and 2024 in 7 major French newspapers.
Note: Incomplete data for 2024 (extraction of content in March 2024).

The length of the sample articles was also heterogeneous, with an average of 3115 characters (i.e., slightly more than one page), but the first quarter clocked at 1529 and the third one at 3828. This implies that most of the coverage was reasonably short, although some articles were not fully available online. Still, this sample is sufficient to perform text analytics – including topic modelling - which can also be adapted to much shorter texts (Qiang et al. 2022).

5. RESULTS

The 14 topics identified in the newspapers' articles were regrouped into five major macro categories and consolidated into 12 individual topics based on their similarities[2]. They are presented in the table below:

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[2] 2 topics were grouped into "Particle physics" due to their similarity. 1 topic was too noisy and constituted of irrelevant words (e.g., work, day, begin, understand, problem…" and excluded from the analysis.

Table 1. Topics related to CERN/LHC in the sample of French media articles

MACRO CATEGORY	TOPIC NAME	TOPIC DESCRIPTION	KEY TERMS	TITLE OF A REPRESENTATIVE ARTICLE	OVERALL SHARE OF SAMPLE
INFRASTRUCTURE	LHC Operations	Insights about the infrastructure of the LHC, including routine operations but also accidents and shutdowns that affect its lifecycle.	LHC, accelerator, collider, proton, energy, beam, ring, machine, magnet	Giant particle accelerator shuts down (Le Figaro 2008)	9.6%
	Computers and Detectors	Heterogeneous topic about specific apparatus and equipment needed at the CERN, especially computers, detectors and issues with supraconductivity.	Detector, power, generation, computer, superconductor	CERN wants to invent the virtual supercomputer (Les Echos 2007)	7%
MISCELLANEOUS	Terrorism and Security	Security issues linked to the CERN, with a specific focus on the case of Adlène Hicheur, a physicist accused of links with Al-Qaida.	Adlène Hicheur, attack, investigation, terrorist, case, police	Adlène Hicheur or the trial of jihadist temptation (Le Monde 2012)	6.1%
ORGANISATION AND POLICY	CERN Organisation	Issues linked to the life of CERN as an organisation, including diplomatic ties, human resources management, leadership, etc.	CERN, research, nuclear, organisation, Geneva, world, director	CERN ends collaboration with scientist after presentation deemed sexist (Le Monde 2018)	7.2%
	Research Policy and Industrial Applications	Heterogeneous topic covering both the research policy linked to CERN (especially the EU one) and potential industrial applications linked to its research (e.g., business linked to CERN).	Research project, European, State, nation, technology, company, billion/million	Europe struggles to coordinate research infrastructures (Le Monde 2007)	7.7%
SCIENCE	Astrophysics	Scientific considerations regarding the contribution of CERN research to our understanding of the Universe, especially on topics such as the Big Bang.	Universe, star, earth, space, big bang, galaxy, black hole, cosmic	The vibrations of the baby Universe (Liberation 2014)	6.4%
	Higgs Boson	Theory, experiments and aftermath of the experimental discovery of the Higgs Boson.	Higgs Boson, particle, mass, standard model, theory	Ten years later, the emotion of the discovery of the Higgs boson remains intact (La Croix 2022)	8.7%
	Neutrino Controversy	Scientific controversy linked to the alleged discovery of neutrinos going faster than light. The topic also contains articles concerned with measurement issues and other particles.	Neutrino, measure, light, experiment, OPERA, speed	Einstein and neutrinos: the suspense continues (Le Figaro 2012)	6.8%
	Particle Physics	Core scientific topic at CERN concerned with particle physics (e.g., quantum dynamics, antimatter…).	Matter, universe, energy, particle, antimatter, atom, electron, quantum physics, question, theory, knowledge	The Strange Universe of Negative Masses (Le Monde 2018)	14.7%

MACRO CATEGORY	TOPIC NAME	TOPIC DESCRIPTION	KEY TERMS	TITLE OF A REPRESENTATIVE ARTICLE	OVERALL SHARE OF SAMPLE
SOCIETY	Culture	Cultural significance of CERN activities, especially in the area near the site in Switzerland and France.	Room, place, offer, visit, rare, open	Science and cinema celebrate their common ground (Le Monde 2014)	5.9%
	Nobel Prize and Awards	Major awards attributed to CERN scientists or related research. Notably deals with the Nobel Prize of Charpak / Higgs. It also contains some articles about outreach at CERN (e.g., students/pupils activities).	Nobel prize, work, physicist, George Charpak	Georges Charpak, the man who wanted to put science within reach (La Croix 2010)	6.5%
	World Wide Web	Contribution of the CERN to the creation of the internet, with a notable focus on Tim Berners-Lee.	Internet, computer, Tim Berners-Lee, network, creation, site	Tim Berners-Lee, the man who gave humanity the web (Les Echos 2014)	6.8%

Figure 3. Topics in French media regarding CERN/LHC over time
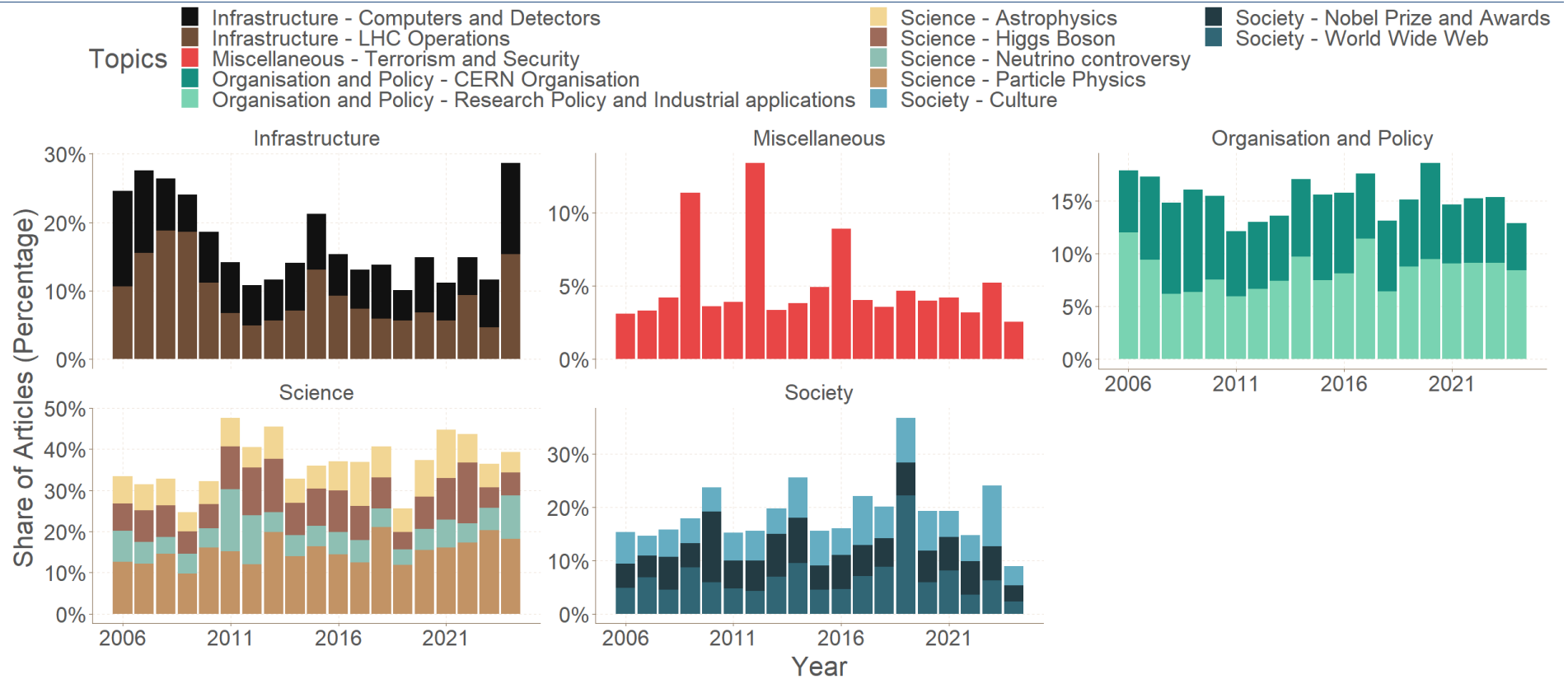
Source: Authors based on a sample of 702 articles published between 2006 and 2024 in 7 major French newspapers. Topic modelling (LDA) with n = 14 topics. 1 topic that did not contain meaningful information was excluded. 2 topics were merged into the Science – Particle Physics. Following these adjustments, 12 individual topics are presented in this graph.

Note: Incomplete data for 2024 (extraction of content in March 2024).

It appears clearly that French newspapers discuss a wide variety of topics when it comes to the CERN/LHC. They dedicate the most attention to science-related issues (typically 30-40% of the sample depending on years), covering particle physics (including specific issues such as the Higgs Boson and the neutrino controversy) and astrophysics. Then, issues with the infrastructure are widely discussed as well (about 15%), for instance, regarding issues impeding the operations of the LHC or the choices and specificities of equipment/technologies to operate this infrastructure. Beyond these technical-scientific considerations, journalists are also widely concerned with the societal impacts of CERN (about 15%), with issues such as cultural benefits, scientific awards, and the development of the internet. Organisation and policy issues are also discussed by journalists and are relatively stable at 15% of the sample over time. Last but not least, terrorism and security issues formed the least discussed topic and are strongly related to the Hicheur incident in 2012.

More generally, the journalists' interest in specific topics tends to be cyclical, with peaks in number of articles corresponding to tractable events. For instance, science coverage was strongly linked to the Higgs Boson discovery and the neutrino controversy of the OPERA experiment. Infrastructure was notably discussed when issues forced the LHC to shut down. Articles about the Internet periodically appear on the anniversary of its invention (e.g., in 2009, 2019).

According to the sentiment analysis performed using the NRC lexicon, the articles mainly contained neutral words. Still, positive words were, on average, more common than negative ones (12% against 4% over the entire period; see Figure below).

Figure 4. Average Share of Words by Sentiment in French media articles about CERN/LHC.
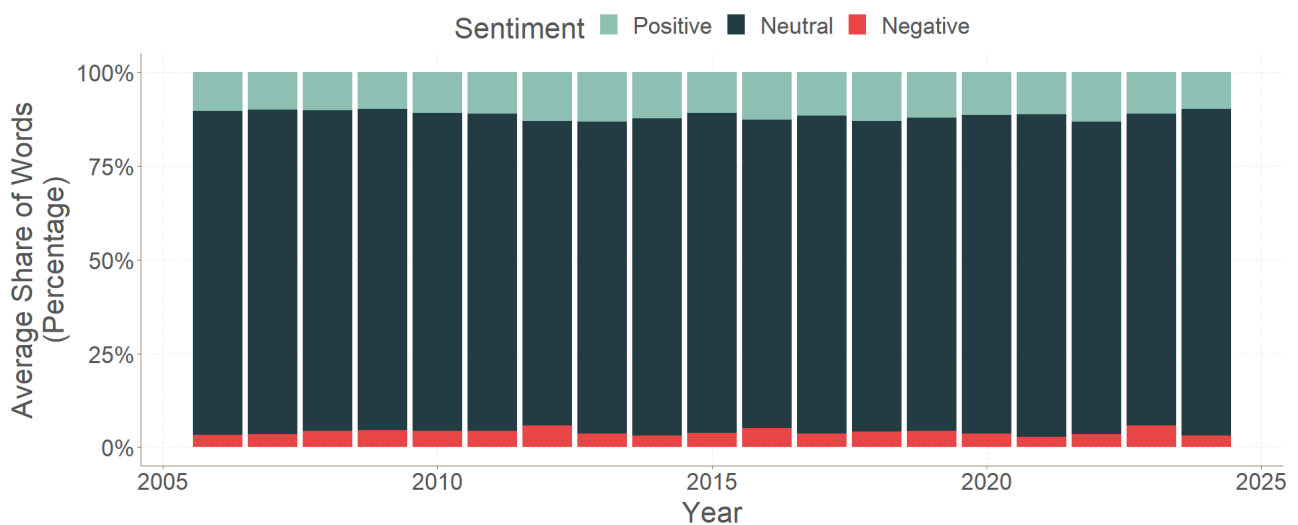
Source: Authors based on a sample of 702 articles published between 2006 and 2024 in 7 major French newspapers. **Note**: Sentiment analysis was performed using the NRC lexicon and word counts. Shares of words were computed for each article for a given year, and then the average of all the relevant articles was derived to obtain these estimates. Data is incomplete for 2024 (extraction in March 2024).

This situation implies that the average sentiment of French media articles about CERN/LHC remained slightly positive during the entire considered period, with three times more positive than negative words[3].

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[3] Average sentiment can be computed by attributing a value of 0 to neutral words, -1 to negative words and +1 to positive words.

This tends to go against some findings of the existing literature studying the content of media articles about large-scale scientific projects or infrastructures. Indeed, as this literature focuses on controversial issues, they often find high levels of polarisation. For instance, in an assessment of media articles about nuclear power construction in Georgia, only about half of the studied articles were found to be "balanced" (Culley et al. 2010).

However, important swings can be noticed on a year-to-year basis. For instance, a low average sentiment was observed in 2009 (5% of net positive sentiment over the total of words), a year characterised by a high-profile terrorism case involving a CERN employee and a prolonged shutdown of the LHC infrastructure. By contrast, high values were observed in 2013, 2014 or 2022 (9% of net positive words). From 2012 to 2013, the Higgs Boson discovery likely explains this situation.

Figure 5. The average net sentiment of French articles dedicated to CERN/LHC over time
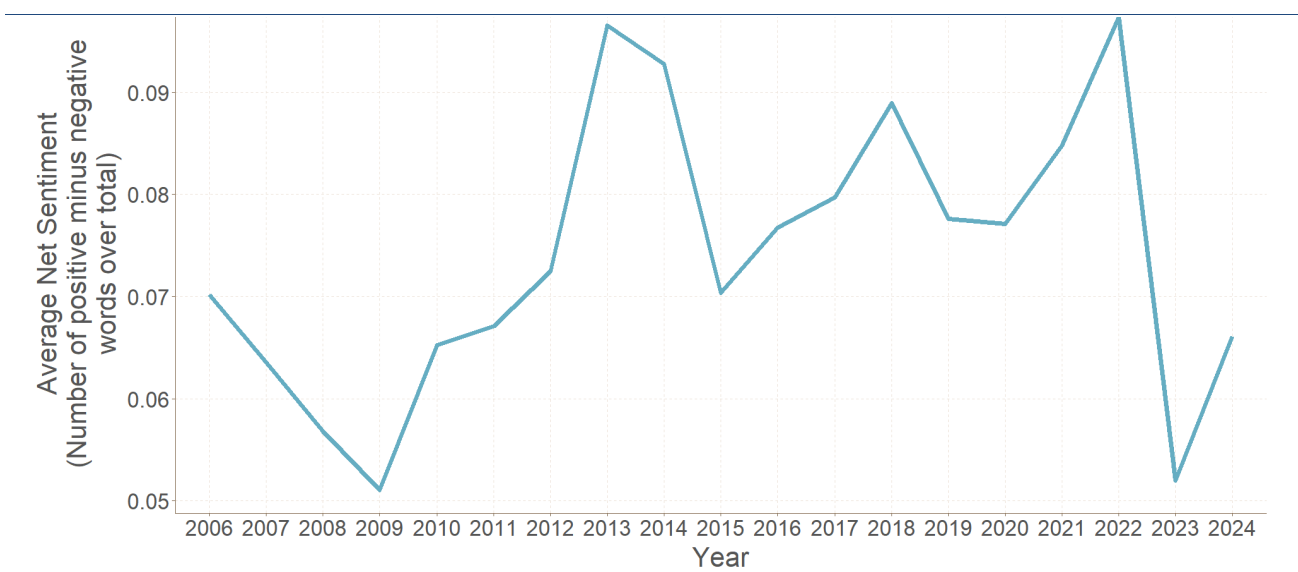
Source: Authors based on a sample of 702 articles published between 2006 and 2024 in 7 major French newspapers.
Note: Sentiment analysis was performed using the NRC lexicon and word counts. Net sentiment was computed at the level of each article by subtracting the number of negative words from the number of positive words and dividing the result by the total number of words. The average of the obtained values was then used to derive these yearly estimates. Data is incomplete for 2024 (extraction in March 2024).

This trend suggests no distinctive change in perceptions of CERN/LHC in recent French media articles. A trend towards higher negativity and/or polarisation could have been assumed in more recent years, owing to the development of social media. Indeed, social media are known to increase pressure on journalists regarding their science coverage (Jamieson, Kahan, and Scheufele 2017a). However, this pressure does not seem to have materialised in the French coverage of CERN/LHC. It suggests that traditional media can still contribute to shaping public perception of CERN/LHC in a relatively positive way, which can be beneficial for the prospects of future projects, such as the FCC.

6. DISCUSSION

In recent years, "big science" projects gained prominence, especially in fields related to physics or engineering (e.g., LHC, FCC…). They require high public support to be launched and sustained during their operation. Traditional media sources – which remain relatively trusted by the public (European Commission 2022; 2021) – are essential since they influence public perceptions. Surprisingly, the scientific literature has dedicated little attention to how large-scale scientific infrastructures are portrayed in the media. Existing research tends to focus on infrastructure related to transportation, civil engineering, or general commitments to science. Furthermore, much of the literature examining the relationship between science and society has concentrated on direct public perception, often through surveys, rather than the potential intermediary role that media coverage may play in shaping these perceptions through its content.

Methodologically, I proposed an approach to investigate the content of articles on large-scale scientific projects/infrastructures based on topic modelling and sentiment analysis. It draws inspiration from content analyses observed in other fields of the literature (Oehmer-Pedrazzi et al., 2023) and can help bridge gaps in how these projects are analysed at this stage. Moreover, this approach can be easily replicated or applied to other types of infrastructures or a broader sample of articles.

This article explores a case of the portrayal of a large-scale scientific project/infrastructure in the media, namely the CERN and the Large Hadron Collider (LHC), in a sample of French newspapers' articles. I focus on the topics covered in the media and analyse the evolution of sentiment in their reporting over time. Specifically, I examine trends to see how coverage has changed, especially in recent years. Key findings from this research indicate a cyclical interest in LHC and CERN among French journalists, with the overall tone of coverage remaining slightly positive throughout the period from 2006 to 2024. There were no apparent signs of increasing polarisation or a significant shift toward more negative coverage, in contrast to the broader observed trends in the literature about science journalism (Jamieson, Kahan, and Scheufele 2017b). Specific events influenced the tone of media reports, such as the positive sentiment generated by the discovery of the Higgs boson, or the negative reactions tied to incidents like terrorism suspicions at CERN. It should be noted that French journalists may be biased in favour of CERN, given the location of its infrastructures at the Swiss French border.

The implications of the findings suggest that traditional media continue to constitute a valuable lever for large scientific institutions to communicate about their activities. Their credibility and resistance to the negativity and conspiracy theories often prevalent on social media highlight their importance in maintaining a balanced narrative. Consequently, communication teams at large-scale research infrastructures or projects should continue to dedicate significant resources to traditional media in combination with alternative channels such as social media. Indeed, traditional media could constitute a beneficial "ally" to promote public support. This is particularly true in the case of CERN, which benefits from a good level of perception, including for its existing LHC. This constitutes a favourable context for future projects, including the FCC. More speculatively, the findings of this study could imply that traditional media could be more mobilised in science policy in favour of large-scale scientific projects/infrastructures, though important disparities across time and space are to be expected.

However, this study has some limitations. The analysis was restricted to French media outlets. These outlets are highly relevant given that the CERN is partly located in this host country. At the same time, it may induce a positivity bias in the coverage of journalists and limit generalisation at a global level. In terms of methodology, the approach to sentiment analysis is relatively basic, lacking consideration of the broader context of the articles. Moreover, there is no direct evidence of how the public received and interpreted these journalistic outputs, as the study did not directly assess audience reactions to the media coverage. Last but not least, the case of the CERN has some important specificities (in terms of field visibility) and the findings may thus not fully generalise to other research infrastructures or large-

scale projects. Future studies may seek to address these limitations, for instance by applying a similar methodology to other fields of science, infrastructures/projects or countries.

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