Scientific uncertainty and sentiment in COVID-19 reporting: An analysis of headlines and article bodies

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ABSTRACT: The COVID-19 pandemic required media professionals to communicate rapidly evolving and often uncertain science to their audiences. This study investigates how scientific uncertainty and sentiment intersect in journalistic materials published during this global health crisis, focusing on differences between general interest and science-focused media. Our analysis is based on a large corpus of journalistic articles that were published at the onset of the pandemic (March–August 2020) and in two additional timeframes, the same months in 2017 and 2023. We used dictionary-based uncertainty detection and automated sentiment analysis to examine headlines and article body content in the two types of publications. Our findings indicate that articles with high scientific uncertainty were more likely to feature negative headlines across both outlet types, though this trend did not extend to body content. COVID-related articles published in 2020 revealed heightened negativity in both headlines and body content for general interest outlets. For specialized outlets, negativity was primarily present in body content. These results contribute to a more nuanced understanding of the complex dynamics between scientific uncertainty and sentiment in the context of public health crises.
KEYWORDS: scientific uncertainty, science journalism, science communication, health communication, sentiment analysis, COVID-19.

TITLU: „Incertitudine științifică și sentiment în relatările presei despre COVID-19: O analiză a titlurilor și conținuturilor articolelor"
ABSTRACT: În timpul pandemiei de COVID-19, profesioniștii mass-media au fost puși în situația de a transmite publicului rezultate științifice aflate în continuă evoluție și incertitudinea din jurul acestora. Studiul analizează modul în care incertitudinea științifică și sentimentul s-au intersectat în materialele jurnalistice publicate în timpul acestei crize globale, concentrându-se asupra diferențelor dintre presa generalistă și cea specializată pe știință. Analiza utilizează un corpus generos de articole jurnalistice apărute la debutul pandemiei (martie–august 2020), precum și în două intervale de timp suplimentare, aceleași luni din 2017 și 2023. Pentru identificarea și cuantificarea incertitudinii științifice, am folosit o metodă care are la bază un dicționar. Acesteia i se adaugă o analiză automată de sentiment aplicată distinct titlurilor și conținuturilor articolelor. Rezultatele arată că materialele jurnalistice caracterizate printr-un nivel ridicat de incertitudine științifică au avut o probabilitate mai mare de a prezenta titluri negative în ambele tipuri de publicații, însă această tendință nu s-a reflectat și în conținutul articolelor. În cazul presei generaliste, materialele despre pandemia de COVID-19 apărute în 2020 au avut mai frecvent atât titluri, cât și conținuturi negative. În schimb, pentru publicațiile specializate, sentimentul negativ a fost prezent în principal în conținuturi. Aceste rezultate contribuie la o înțelegere mai nuanțată a dinamicilor complexe dintre incertitudinea științifică și sentiment în contextul crizelor de sănătate publică.
CUVINTE-CHEIE: incertitudine științifică, jurnalism de știință, comunicare științifică, comunicare medicală, analiză de sentiment, COVID-19.

Introduction

The COVID-19 pandemic changed life as we knew it. This disruptive event put unprecedented demands on the scientific community, the medical body, and the media. During the first ten months of 2020, a period that marked the beginning of this global health crisis, approximately a quarter of all front-

page online journalistic materials were focused on this topic (Krawczyk et al. 2021). Many of the stories were built around the changing guidelines of the pandemic, the restrictions, or the number of deaths, all of which can evoke negative sentiments (Stainback et al. 2020; Van Scoy et al. 2021).

From a science communication perspective, this pandemic placed the issue of communicating scientific uncertainty into the spotlight and highlighted the role of journalism in translating evolving scientific knowledge for the public (Capurro et al. 2021). Scientific uncertainty is a fundamental characteristic of the advancement of knowledge, because the scientific process is iterative, with researchers striving to reduce uncertainty rather than eliminate it (Baruch and Davis 2014). Over the course of this health crisis, journalists had to explain often preliminary and constantly changing information to their audiences in real-time, information characterized by a heightened degree of uncertainty (Ratcliff et al. 2022). Media professionals faced multiple other difficulties, from working long hours and managing their personal mental health to addressing rising threats and issues associated with press freedom and the spread of misinformation (Kreps & Kriner, 2020; Pentzold et al. 2021; Litvinenko et al. 2022). This complex situation left little room for the traditional processes of verification or contextualization (Vraga and Bode 2020).

Science communication scholars and experienced journalists recommended media professionals and health communicators to be open and transparent about what is known and unknown regarding the virus and the disease, tailoring their reports to the needs, knowledge levels, and emotional states of their audiences (Finset et al. 2020; Kreps & Kriner 2020; Malecki et al. 2021; van der Bles et al. 2020). They also suggested that journalists explain how science works, how it corrects itself, and why scientific uncertainty is part of the process (Marín-González et al. 2023). According to prior research, transparent communication can offer positive outcomes in the long run (Kreps and Kriner, 2020; Batteux et al. 2021). On the flip side, vague information or overly optimistic messages may make the public susceptible to conspiracy theories (Petersen et al. 2021). Research from before the pandemic noted differences in how journalists tackle scientific uncertainty based on their experience and the type of publications they worked for (Nisbet and Fahy 2015). This was also noticed during the health crisis. Media professionals who were specialized in science (had a scientific background or experience on the job) were generally better informed and were better able to explain scientific uncertainty compared to those who occupied more generalist roles and often lacked the training to engage with complex scientific topics (Ratcliff 2021; Fleerackers et al. 2022; Fiscutean and Rosu 2025).

At the same time, the emotional tone of science journalism stories also played a role in shaping public perceptions of the pandemic, because sentiment affects how readers interpret and engage with scientific information on an emotional level (Bilandzic et al. 2020). The emotional framing of news, particularly in headlines, can influence public perception and can affect the public's view of science and its institutions (Jaspal and Nerlich 2020; Ifantidou 2023). One way to assess that is through sentiment analysis, a method that, up until recently, was underutilized in media studies. Historically, sentiment analysis was more common in financial journalism, where it was linked to market behavior (Valencia et al. 2019). In recent years, it started to be used in other domains of communication research, including political communication (Ring et al. 2024) and, to some extent, science journalism, particularly in the niche of health reporting (Taufek et al. 2021; Marques et al. 2022). Using sentiment analysis is increasingly relevant nowadays when studying how writing practices evolve, given the growing tendency toward negativity in headlines (Rozado et al. 2022).

During the COVID-19 pandemic, sentiment analysis was mostly used analysis of social media posts and comments to examine potential changes in how the public perceived the health crisis (Sukhavasi et al. 2023). However, sentiment analysis is also relevant when examining journalistic materials. Given the bleak and emotionally charged nature of the pandemic (Nicomedes and Avila 2020), media professionals who covered it had to make difficult decisions on the language they used. Studies that analyzed major English-speaking publications revealed a consistent emphasis on emotions such as sadness, anxiety, denial, and annoyance (Montesinos-Yufa and Musgrove 2024; Chandra et al. 2025). In the UK, a study that examined media coverage of the pandemic found that over 73% of headlines were negative, while only 27% conveyed a positive tone (Montesinos-Yufa and Musgrove 2024). A fairly

large proportion of the COVID-19-related online news articles, around 16%, were highly negatively polarized, focusing on themes like death, fear, or crisis, with death being more present in the news compared to pre-pandemic times (Krawczyk et al. 2021).

Despite the importance of scientific uncertainty and sentiment taken together, few studies have looked at their intersection, particularly in the context of the COVID-19 pandemic, an event that offered a unique opportunity to explore these factors and their influence on science journalism. This study aims to address this gap. We investigated whether science journalism articles published during the COVID-19 crisis had a tendency toward negative or positive sentiments in both their titles and body content, and how these potential patterns intersected with the levels of scientific uncertainty present in these materials. We included journalistic articles from both general interest and science-focused outlets to uncover potential differences in reporting styles.

We considered the following hypotheses (H1–H9):

H1: Journalistic articles with a high degree of uncertainty are more likely to have negative titles in both general interest and specialized media.

H2: Journalistic articles with a high degree of uncertainty are more likely to have negative bodies in both general interest and specialized media.

H3: Journalistic articles with a high degree of uncertainty are more likely to have positive titles in both general interest and specialized media.

H4: Journalistic articles with a high degree of uncertainty are more likely to have positive bodies in both general interest and specialized media.

H5: In 2020, COVID-related articles were more likely to have negative titles than non-COVID articles for both general interest and specialized media.

H6: In 2020, COVID-related articles were more likely to have negative bodies than non-COVID articles for both general interest and specialized media.

H7: In 2020, COVID-related articles with high uncertainty were more likely to have negative titles than COVID-related articles with low uncertainty in both general interest and specialized media.

H8: In 2020, COVID-related articles with high uncertainty were more likely to have negative bodies than COVID-related articles with low uncertainty, in both general interest and specialized media.

H9: Articles that included references to preprints were more likely to have negative titles and bodies than those that did not mention preprints in both general interest and specialized media.

Methods

Our investigation considered a large corpus of journalistic materials from both general interest and specialized media published during these periods: the early phase of the COVID-19 pandemic (March 1 - August 31, 2020), three years prior, as a baseline (March 1 - August 31, 2017) and three years after (March 1 - August 31, 2023), with the third interval intersectit with the declared end of the health crisis. Following the data collection and analysis methodology applied by Fiscutean and Rosu (2025), the articles originated from two types of media: general interest (*The Guardian*) and science-focused (*Scientific American, National Geographic*, and *Quanta Magazine*). To make sure that the analysis only considered science journalism stories, we applied a keyword-based filtering system: we selected only journalistic materials that included at least one mention of the terms *study* or a variant of *research* (e.g., *research, researchers, researching*). This allowed us to exclude articles that mentioned COVID-19 without engaging with scientific content, as during this health crisis, a large proportion of stories on other beats mentioned COVID-19 or SARS-CoV-2 in passing. Furthermore, we filtered out journalistic materials that did not qualify as articles, such as opinion pieces, author profile pages, live update feeds, blog entries, and podcast transcripts or summaries. To analyze journalistic trends related to the COVID-19 pandemic, we considered two groups: (1) articles that

mentioned the words *COVID* and *coronavirus* at least three times and (2) articles that did not mention these terms at all, following the methodology described by Fiscutean and Rosu (2025). This conservative threshold was established to ensure that materials in the COVID-19-related group engaged substantively with the topic, rather than making incidental references to it. The dataset comprised of 4,399 articles, 77.22% of which were from the general interest media and the remaining 22.78% from science-focused publications. In terms of distribution by year, 30.96% of the articles were published in 2020, while 35.87% appeared in 2017, and the remaining 33.17% in 2023.

To measure scientific uncertainty, we used a dictionary-based approach, assessing the prevalence of scientific uncertainty linguistic markers present in both general interest and specialized media. The set of words employed was a previously validated one (Fiscutean and Rosu 2025), integrating terms used by Zerva et al. (2017), Dral et al. (2011), and Kreye et al. (2022). The dictionary included N=100 terms related to knowledge gaps (e.g., *unknown, yet unclear, to the best of our knowledge*) and speculative language (e.g., *hypothesize, speculate*), with all scientific uncertainty markers being considered equal. By identifying the frequency of these terms in each journalistic material, we were able to quantify how often scientific uncertainty was communicated and compare patterns between general interest and science-focused outlets over the chosen timeframes. Each journalistic material in the dataset was then classified as "high uncertainty" (HU) if its score exceeded the median and "low uncertainty" (LU) if its score was at or below the median, with median values being conservatively placed in the LU category. Additionally, for journalistic materials published in 2020 on the topic of the pandemic, we examined direct mentions of the term *preprint* and other related terms (e.g., *not peer reviewed*, *pre-publication, awaiting review*).

The next step was to assess the sentiment (positive, neutral, negative) each headline and article body carried. For this, we used *pysentimiento*, a multilingual Python library for opinion mining and social NLP. Created by Pérez et al. (2021), this toolkit uses transformer-based language models that are optimized for sentiment analysis in English and three other languages: Spanish, Italian, and Portuguese. Previous research has shown that it allows for a nuanced and context-aware interpretation of written materials, and can be applied to studies such as ours. *Pysentimiento* was chosen because it showed high accuracy, speed, as well as an implementation that was more user-friendly compared to other BERT-based models (Mariscal et al. 2024). The library's "predict" method provides a structured output, which includes the most likely sentiment label (positive, neutral, negative) and the probabilities associated with each class. By using *pysentimiento*, we were able to automate sentiment classification for our large dataset. Our analysis considers headlines and article bodies separately, given (1) the potential differences between the sentiment carried by the two and (2) the fact that, oftentimes, the spread of online content is fueled by reading the title and perhaps a snippet of text, not the entire material (Sundar et al. 2024). In headlines, neutral sentiment accounted for 56.22%, while negative and positive sentiment represented 33.46% and 10.32%, respectively. A slightly different pattern was observed in the body of the articles, where neutral sentiment accounted for 63.47%, followed by negative (23.60%), and positive (12.93%).

Results

Our hypotheses explore the intersection of scientific uncertainty and sentiment (positive, neutral, negative) of journalistic materials published in the context of the COVID-19 pandemic. The first two hypotheses are more broad in focus: **H1** and **H2** argue that articles classified as High Uncertainty across all time intervals are more likely to feature negative sentiment in their headlines (**H1**) and bodies (**H2**) in both types of media, a result that can be expected given the nature of the health crisis and the potential changes in editorial practices. In contrast, the following two hypotheses, **H3** and **H4**, aim to explore the possibility that High Uncertainty articles might employ positive sentiment in their headlines (**H3**) and bodies (**H4**).

Furthermore, the analysis considers COVID-related materials published in 2020. Hypotheses **H5** and **H6** examine whether articles related to the pandemic were more likely to include negative sentiment in headlines (**H5**) and body content (**H6**) compared to non-COVID ones. This can be expected given the

heightened emotions and stakes associated with the pandemic. Further narrowing the focus, **H7** and **H8** predict that within COVID-related materials, those in the High Uncertainty category are more likely to feature negative framing than those categorized as Low Uncertainty.

Finally, **H9** examines the relationship between sentiment and direct mentions of the word "*preprint*" and similar terms. The hypothesis tests whether articles referencing preprints were more likely to have negative headlines and body content.

Hypothesis 1, which states that high-uncertainty articles are more likely to have negative titles in both general interest and specialized outlets, was supported. When we examined articles from general interest media, the Pearson's Chi-Squared test with Yates' continuity correction yielded a statistically significant result (χ-*squared* = 18.64, df = 1, p < .001), which indicates a strong association between high uncertainty and negative headlines. The same analysis, when applied to science-focused outlets, showed a significant result as well (χ-*squared* = 8.96, df = 1, p = 0.003). The findings are illustrated in **Figure 1** below. These results suggest that both types of outlets had a tendency to frame high-uncertainty articles with more negative headlines.

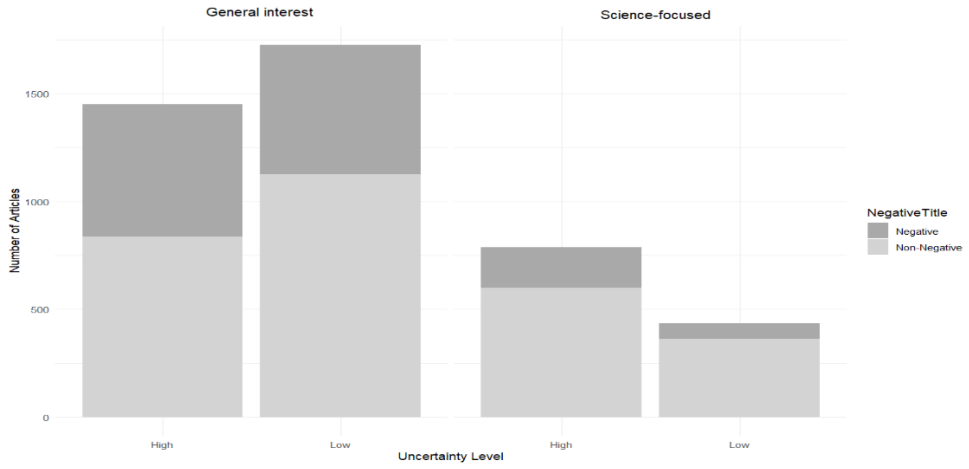

Fig. 1. Prevalence of negative headlines in general interest and specialized media, categorized by levels of scientific uncertainty.

In contrast to the pattern observed in headlines, the relationship between scientific uncertainty and negative sentiment in the article body revealed different results. **Hypothesis 2**, which proposed that high uncertainty articles were more likely to have negative sentiment in the body of the text in both general interest and specialized media, was not supported.

For general interest media, the Chi-Square test with Yates' continuity correction yielded a non-significant result (χ-*squared* = 1.39, df = 1, p = 0.24), which indicates that there is no meaningful connection between high uncertainty and negative sentiment in the body of the articles. In the same vein, for science-focused outlets, the test provided no significant association between sentiment and high uncertainty (χ-*squared* = 0.40, df = 1, p = 0.53).

As shown in **Figure 2**, these findings suggest that there can be a disconnect between the way headlines are framed, and the way the body of articles is constructed, regardless of the type of outlet.

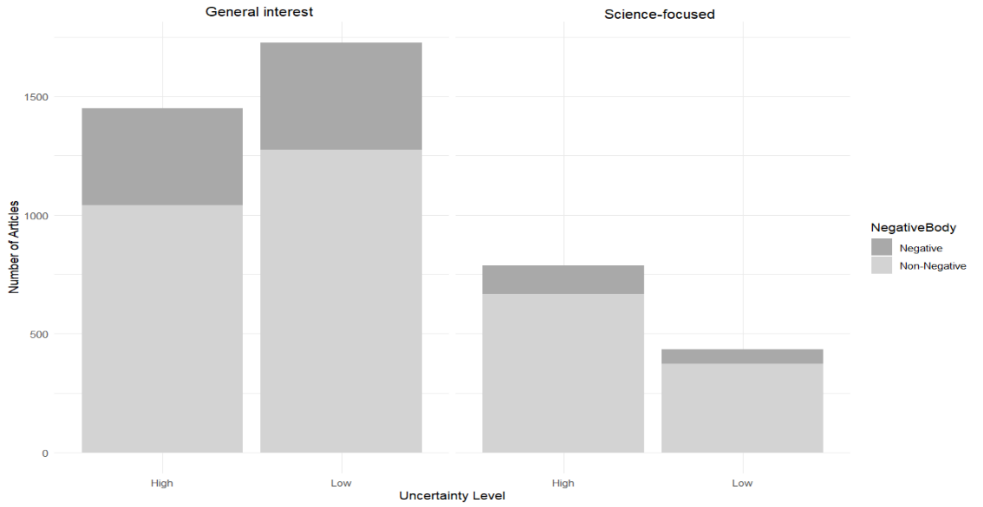

***Fig.* 2. Prevalence of negative bodies in general interest and specialized media, categorized by levels of scientific uncertainty.**

The following two hypotheses (**H3** and **H4**) shift the tone and examine the use of positive sentiment in headlines and article bodies in the context of scientific uncertainty. The first, **Hypothesis 3**, which argues that high-uncertainty articles are more likely to have positive titles in both general interest and specialized media, was only partially supported.

For materials that appeared in the general interest media, the test revealed a statistically significant result (χ-*squared* = 3.87, df = 1, p = 0.049), showing a measurable association between high uncertainty and positive sentiment in headlines. However, this trend did not hold for science-focused outlets (χ-*squared* = 1.44, df = 1, p = 0.23), which suggested no strong link between high uncertainty and positive titles in this type of media, as seen in **Figure 3**.

These findings point to a divide in writing practices. While specialized outlets tend to emphasize accuracy in headlines, general interest publications appear to be more willing to highlight hopeful angles.

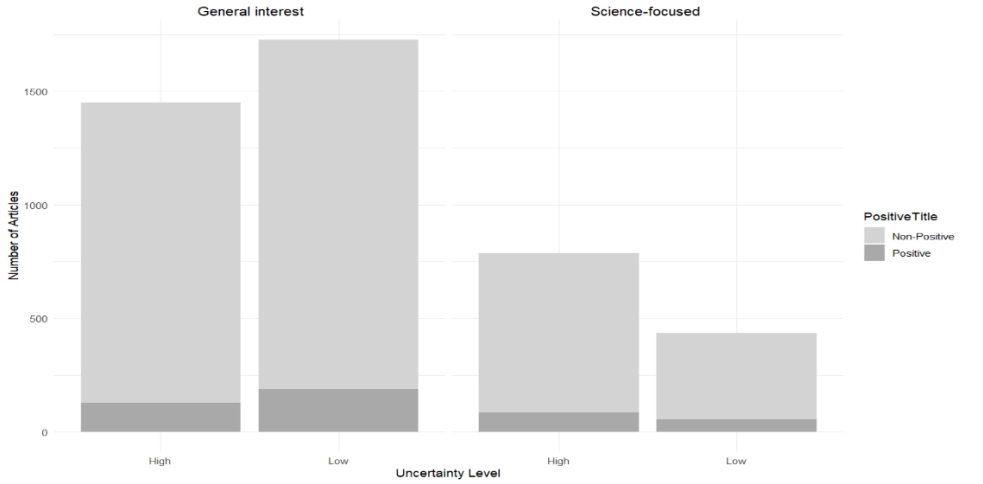

***Fig. 3.* Prevalence of positive headlines in general interest and specialized media, categorized by levels of scientific uncertainty.**

Hypothesis 4, which states that high uncertainty articles are more likely to have positive body sentiment in both general interest and specialized media, was again only partially supported. This time, however, specialized publications showed a statistically significant association between high uncertainty and positive body sentiment (χ-*squared* = 3.90, df = 1, p = 0.048), which suggests that high uncertainty articles were more likely to feature positive sentiment within their body.

By contrast, for general interest media, we did not find a statistically significant association (χ-*squared* = 2.31, df = 1, p = 0.13), which indicates that there is no strong link between high uncertainty and positive body sentiment in general interest media, as illustrated in **Figure 4**.

Again, we notice a difference in writing practices. Science-focused publications may potentially be more nuanced in the body of the article, adopting a more constructive or optimistic tone when dealing with scientific uncertainty, possibly seeing it as a normal part of the scientific process.

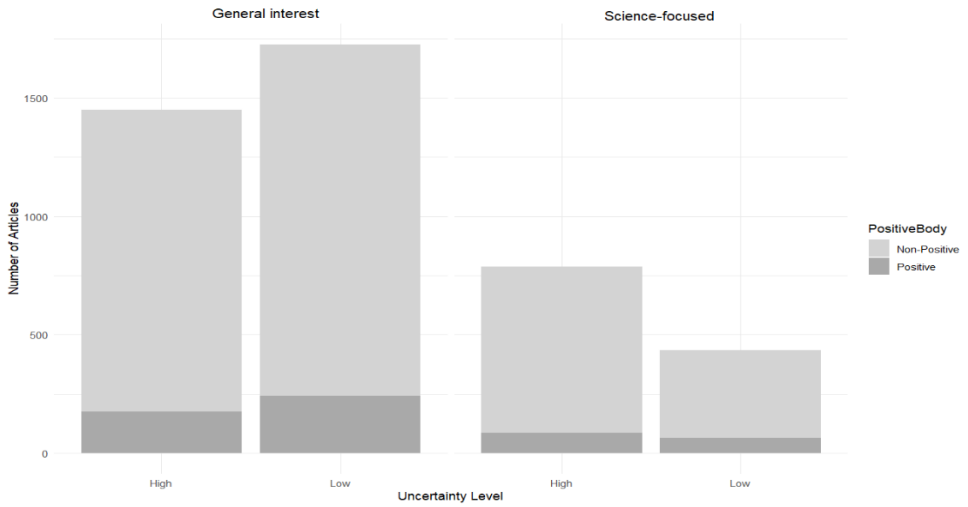

***Fig.* 4. Prevalence of positive bodies of articles in general interest and specialized media, categorized by levels of scientific uncertainty.**

The following Hypotheses, **H5** and **H6**, further narrow the focus, targeting articles published in 2020, the year when the COVID-19 pandemic started. They explore whether COVID-19-related articles were more likely to feature negative sentiment compared to non-COVID ones, both in their titles (**H5**) and bodies (**H6**), across the two types of media, general interest and science-focused. After applying statistical tests, we noticed that COVID-related journalistic materials were significantly more likely to have negative titles (**H5**) compared to those covering other topics in general interest media.

The Chi-Square test yielded a statistically significant result (χ-*squared* = 14.14, df = 1, p < 0.001), which indicates a strong association between COVID-19-related content and negative sentiment in article titles. In contrast, science-focused publications did not show a statistically significant difference when it came to negativity in headlines between COVID and non-COVID materials (χ-*squared* = 3.03, df = 1, p = 0.08). **Figure 5** illustrates these findings.

The analysis suggests that general interest media may have leaned more heavily on negative framing in headlines during the early stages of the pandemic, in contrast with the specialized outlets, which maintained a more stable tone regardless of topic.

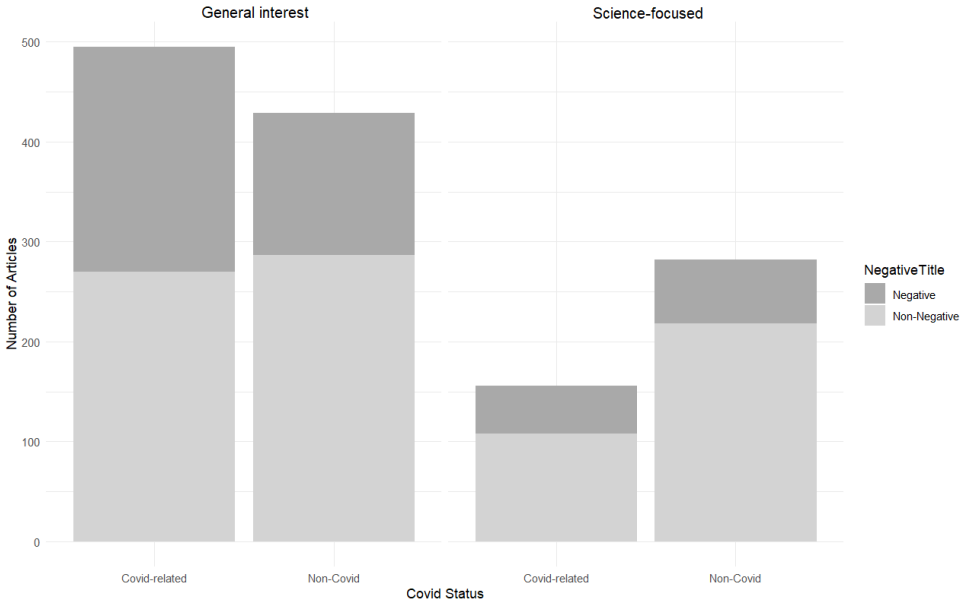

Fig. 5. **Negative headline prevalence in COVID-19 and non-COVID-19 articles published in 2020 across general interest and specialized media.**

When we tested **H6**, which posits that, in 2020, COVID-related articles were more likely to have negative bodies than non-COVID articles for both general interest and specialized media, we noticed a tendency towards negative sentiment in general interest media (χ*-squared* = 19.84, df = 1, $p < .001$), as well as in science-focused outlets (χ*-squared* = 15.90, df = 1, $p < .001$), as illustrated in **Figure 6**.

These results suggest a consistent pattern of more negative sentiment in the body of COVID-related articles across both types of publications.

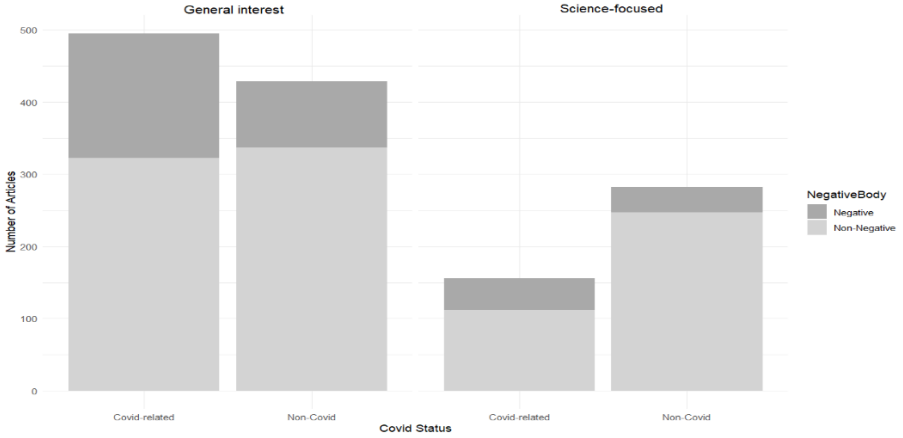

Fig. 6. **Negative body prevalence in COVID-19 and non-COVID-19 articles published in 2020 across general interest and specialized media**

Moving forward, we aimed to intersect scientific uncertainty and sentiment in COVID-19 materials published in 2020. For **H7**, we noticed COVID-related articles with high uncertainty were not significantly more likely to feature negative headlines compared to those with low uncertainty, as shown in **Figure 7**. For the general interest publication, the Chi-Square test produced χ-*squared* = 0.55, df = 1, p = 0.46, while for science-focused publications, the results were also non-significant (χ-*squared* = 0.30, df = 1, p = 0.58). This suggests that the level of uncertainty in COVID-related articles did not consistently influence the negativity of their headlines in either type of publication.

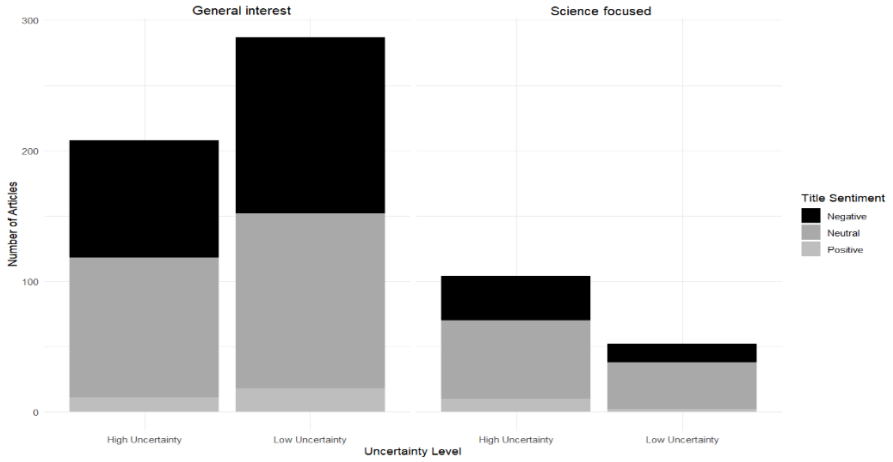

Fig. 7. **Title sentiment in COVID-19-related articles from 2020, by level of scientific uncertainty, across general interest and specialized media.**

Next, we tested **H8**, which stated that in 2020, COVID-related articles with high uncertainty were more likely to have negative bodies than COVID-related articles with low uncertainty, in both general interest and specialized media. However, our analysis did not support this hypothesis. The Chi-Square test yielded non-significant results for both general interest media (χ-*squared* = 0.53, df = 1, p = 0.467), and for science-focused outlets (χ-*squared* = 1.43, df = 1, p = 0.23), as shown in **Figure 8**. These findings suggest that, within COVID-related reporting, the level of scientific uncertainty did not imply having a negative tone in article body content, regardless of outlet type.

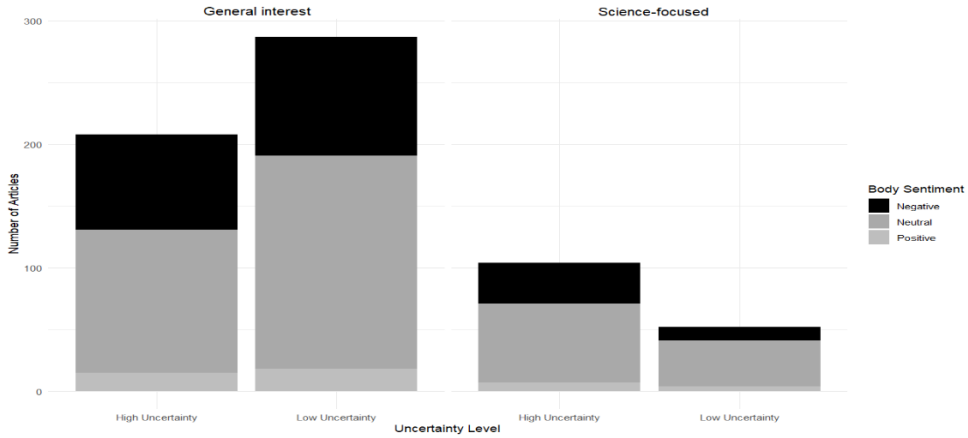

Fig. 8. **Body sentiment in COVID-19-related articles from 2020, by level of scientific uncertainty, across general interest and specialized media.**

Finally, **Hypothesis H9** looked at articles that included direct references to words like *preprint* or *awaiting peer-review* and the sentiment they convey in both general interest and specialized. We found no significant associations in either general interest or science-focused media. For headlines, the Chi-Square test yielded non-significant results for the general interest media (χ-*squared* = 0.30, df = 1, p = 0.59), as well as science-focused (χ-*squared* < .001, df = 1, p = 1). For body content, again, no significant results were found fo general interest (χ-*squared* = 0.04, df = 1, p = 0.84) and specialized (χ-*squared* = 1.77, df = 1, p = 0.18) media. Therefore, our analysis suggests that mentioning *preprints* directly in a journalistic piece was not significantly associated with negative headlines or negative bodies across the outlets analyzed.

Discussion

Our study analyzed the intersection of scientific uncertainty and sentiment in science journalism, specifically in the context of the COVID-19 pandemic. We examined two types of media, general interest and science-focused, and looked at both headlines and article bodies. Our study revealed a complex, nuanced and sometimes divergent relationship between scientific uncertainty and sentiment. We identified three themes: (1) a disconnect between headline sentiment and article body sentiment; (2) divergent writing practices of conveying scientific uncertainty in general interest and specialized media; and (3) topic-specific impact of the pandemic on sentiment.

Perhaps one of the most striking findings of our study was the disconnect between headline and body content. We found strong support for **H1**, indicating that articles with high uncertainty were broadly associated with negative headlines in both media types. However, this pattern did not appear to translate to article bodies (**H2**). One explanation could derive from the journalistic practice of writing headlines that grab the attention, but are followed by a more balanced take in the article body, a tendency observed by prior researchers (Ebrahim 2022; Rozado et al. 2022). In the months that followed the official start of the COVID-19 pandemic, negative headlines for high-uncertainty topics may have been chosen to signal that the threat was a serious one, to convey urgency and capture reader attention. While this practice of using emotionally-charged headlines may be effective for engaging some members of the public, it can raise ethical questions. Since many readers only skim headlines, they may have a negative and alarming impression of the news, while at the same time missing the more nuanced discussion presented in the body of the text. The lack of negativity in the body content and the misalignment between the tone of the headline and the story may suggest that journalists aim to preserve accuracy and do justice to their piece. It also points to a subtle tension between grabbing the attention of the reader and doing science reporting with care and integrity.

When it comes to high uncertainty articles and positive sentiment (**H3** and **H4**), our study showed discrepancies between the two types of media analyzed. General interest media were more likely to pair high uncertainty with positive titles, but not positive bodies. Science-focused media did the exact opposite: they did not use positive titles but were more likely to feature positive sentiment within the article body. Prior research showed that health journalism traditionally emphasizes optimism, encouraging preventive behaviors or raising expectations for medical breakthroughs (Nabi et al. 2024). Our results suggest that general interest media appeared to use positive framing in headlines perhaps as a tool for reassurance, while science-focused media adopted a more cautious approach to headlines, avoiding positive spins. However, the statistically significant presence of positive sentiment within the body of high-uncertainty articles in specialized publications may suggest that these outlets framed their stories in a more nuanced manner, which was more in line with the guidelines for science journalism issued before and during the COVID-19 pandemic.

When analyzing data from 2020, we noticed that COVID-19 articles published in general interest media were more likely to have negative titles than those in the non-COVID-19 category (**H5**), which suggests that this type of media had a heightened negative framing, a tendency that was not seen in science-focused outlets. However, when we examined article bodies (**H6**), we discovered a propensity towards negativity in both types of publications. The negativity present in article body content may be a reflection of the global health crisis rather than sensationalism.

Our study also showed non-significant results for **Hypotheses H7**, **H8**, and **H9**, results which are equally important. The analysis showed that within the category of COVID-19 articles, high uncertainty did not lead to a further increase in negative sentiment in titles (**H7**) or bodies (**H8**). In other words, the presence of uncertainty did not necessarily make stories sound more negative. Additionally, we observed a lack of significant association between direct mentions to preprints and negative sentiment, which suggests that non-peer-reviewed papers do not necessarily lead to articles that carry negative sentiment.

Our study has several limitations. Automated analysis for uncertainty and sentiment, while robust and useful when processing a large dataset, cannot capture all the nuances. Also, the binary classification of "high" and "low" for scientific uncertainty, and the dictionaries used (with the equal weight given to the linguistic markers) are also simplifications and can be addressed in future studies. Additionally, our study only included four English-speaking outlets, which might not capture the entire spectrum of publications that covered the pandemic. The keywords we used to filter the stories can also influence the data collection process, as we might have excluded articles that discussed COVID-19-related topics without explicitly using selected terms. Furthermore, we did not take into account other factors that might have influenced article framing, such as editorial policy, the scientific literacy of audiences, or the role of visual elements that were incorporated into the stories. Future studies could include a more diverse range of outlets, which could potentially provide more nuanced conclusions, potentially revealing geographical differences. Additionally, qualitative analyses could provide a deeper understanding of how uncertainty and sentiment interplay in science communication. Last but not least, experimental research on reader reception is needed to determine to what extent different writing practices can influence the public understanding of science and the trust in science.

Conclusion

This study examined how scientific uncertainty intersected with sentiment in COVID-19 reporting in two types of media: general interest and science-focused. Our findings show a headline-body disconnect, where negative headlines are used as an engagement tool for uncertain science, even when the article body is neutral. Several differences between outlet types were observed: general interest publications tended to frame uncertainty with both negative and, at times, positive headlines, while specialized outlets reserved positive sentiment for the article body. Additionally, COVID-19-related articles in 2020 were significantly more negative in both headline and body sentiment, particularly in general interest media. These results suggest a complex relationship between scientific uncertainty and sentiment that has implications for other public health crises.

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