Predicting COVID: Understanding audience responses to predictive journalism via online comments

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Abstract
The COVID-19 pandemic triggered a global health crisis that stimulated journalists to frame their stories around predictive models and forecasts aiming to predict the future trend of the pandemic. This article examines the audience response to predictive journalism by qualitatively analyzing readers’ comments to articles covering COVID that were published in a small sample of mainstream media. Based on a thematic analysis of readers’ comments, this research contributes a typology of audience response types to the models incorporated in such predictive journalism. We elaborate on each of three primary themes—reflecting affective, action-oriented, and evaluative responses—and discuss the implications of our findings and the importance of expanding research to answer questions related to the role of predictive journalism in shaping affective response, encouraging action-oriented responses and collective planning around responsibility for taking future actions, and considering the ways in which supportive and critical comments triggered by the models may be harnessed to improve communication.

Keywords
COVID-19, data journalism, online comments, predictive journalism

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Introduction

Predictive journalism is an emerging genre within data journalism that incorporates predictive information such as estimations, forecasts, or nowcasts into news production processes (e.g. reporting, publication, distribution) by using or relying on data-driven computational techniques such as predictive analytics or computer simulations (Diakopoulos, 2022). One potential application of predictive journalism is to assist the public in reasoning under uncertainty about possible future events and outcomes. For example, in 2008, FiveThirtyEight began to popularize this genre of journalism in election predictions to answer the question of who is leading the elections and who is likely to win. The accessibility of big data paired with advancements in computational power has also enabled journalists to cover stories beyond election forecasts and political polling (Toff, 2019) such as weather forecasts as well as entertainment (Franck and Wilson, 2020) and sports predictions (Pentzold and Fechner, 2020) and more recently projecting the number of COVID-19 cases in the future.

Throughout the COVID-19 pandemic, journalists utilized epidemiological and forecasting models to offer reports and infographics informing the public about the scale and pace of the health crises amid a wave of muddled information (Pentzold et al., 2021). Yet despite the prominence of this type of journalism throughout the course of the pandemic, little is known about how such predictions, themselves full of uncertainty, are received by audiences and might influence public attitudes and emotions toward the pandemic. Accordingly, our research primarily focuses on answering the following question: How did the public respond to COVID-19 models conveyed in predictive journalism articles published in US-based news media?

This research aims to understand the impact of predictive journalism on audiences by qualitatively analyzing the comments section of a sample of such news articles from three US-based news outlets: The New York Times, The Washington Post, and FiveThirtyEight. The digital medium of predictive journalism combined with the deliberate and thoughtful engagement from readers via online comments offers a unique opportunity to understand how people respond to predictive models and forecasts in news media (Hullman et al., 2015). Because comments are generally unsolicited and reflect readers’ raw reactions to news content, they provide a rich and ecologically valid window into how some people in the audience are responding to the predictions. In this work, we analyze 885 comments made in response to six articles, applying an iterative qualitative thematic analysis approach to uncover patterns and themes in user reactions.

Our findings contribute a typology of responses to predictive journalism that articulates three main themes (affective, action-oriented, and evaluative responses) as well as several subthemes which emerged from the thematic analysis of readers’ comments in our sample. We found that the focal point of readers’ comments was largely on the predictive models described in the sampled articles; thus, these themes reflect readers’ responses that are specific to the models. Affective response reflects the emotions expressed as a result of analyzing and interpreting the models. Action-oriented response includes all comments requesting or demanding an action to be taken based on the numbers conveyed by the models. Evaluative response comprises a variety of supporting and critical comments that are relevant to the models.
Building on these findings, our discussion offers further insights into the emotionality in public response to predictive models in journalism, how these models can encourage action-oriented responses and collective planning around responsibility for taking future actions, and the type of supportive and critical comments that these models trigger among commenters. Predictive journalism has an apparent capacity for impacting public emotions, attitudes, and behavior, which are consequential to the ways in which the public makes sense of news information. Developing this typology of responses is an important initial contribution toward understanding the range of responses to predictive journalism that can inform future research in operationalizing such responses as well as suggest ways for journalistic practice to better communicate predictions and forecasts about the future. This work thus outlines a first step in a larger research program examining the role of predictive journalism in the news media, and how this genre of journalism may shape public attitudes and opinions about future events and public policy for a variety of social processes that are predicted in the news.

**Background: predictive journalism in the COVID-19 pandemic**

The COVID-19 pandemic triggered broad intolerance of uncertainty around policy responses and when life would return to “normal” as well as other emotions such as fear, stress, depression, and anxiety (Coelho et al., 2020; Pakpour and Griffiths, 2020). Media exposure, health anxiety, and risk for loved ones were predictors of fear of the coronavirus (Chu et al., 2022; Mertens et al., 2020). Traumatic stress symptoms and fear of economic factors were also associated with the coronavirus (Jacmin-Park et al., 2020).

COVID-19 thus created a public need for orientation and information seeking due to the high uncertainty about the future and its relative impact on peoples’ lives. Research by McCombs and Weaver (1973) on the need for orientation suggests that people’s motivation to learn about their social environment increases with uncertainty and relevance. Accordingly, it is plausible for the public to seek information from the news during crises.

During the COVID-19 crisis, journalism acted as a facilitator and a communication channel between public officials and experts and the broader public (Perreault and Perreault, 2021). In the United States, for example, early news coverage of the COVID-19 pandemic communicated to the public constant updates about prevention policies (Basch et al., 2020). Nevertheless, a large degree of uncertainty and speculation remains in news making (Neiger, 2007; Spiegelhalter, 2017), especially when predicting the future. As more data, technologies, and computational power become accessible to journalists, MayCotte (2015) foresaw the potential of predictive journalism in news making: “journalists will be able to orchestrate predictions and write tomorrow’s headlines and stories”. News organizations ventured into predictive journalism after recognizing the ability of predictive analytics to generate “pre-emptive knowledge” about the future and shape the formulation of knowledge claims in newsmaking (Pentzold and Fechner, 2021).

In response to the coronavirus outbreak, many news outlets developed their own data-driven predictive models and simulations to report on the possible impact of preventive policies and health measures on case counts and mortality rates (Diakopoulos, 2022).
Readers were given the opportunity to engage with these models through exploring different possible future outcomes and scenarios by modifying some of the underlying assumptions and configurations of these models. Journalists have also incorporated third-party predictive models into their news reporting (e.g. the IHME model) when thinking about the future and imaging tradeoffs between short-term decisions and long-term effects (Colglazier and Diakopoulos, 2022). For instance, The New York Times published an article entitled “What 5 Coronavirus Models Say the Next Month Will Look Like” (Bui et al., 2020) comparing five different predictive models forecasting case counts, hospitalizations, and deaths and how these models are guiding current public policies. It is evident from the title of this article that the focus of predictive journalism is on informing the public about possible and predicted future outcomes and how such outcomes could possibly have an impact on society.

The majority of prior academic research on predictive journalism has been focused on either interpreting model outcomes, describing journalistic practices in this genre of data journalism, or the way models were presented to the public (Pentzold et al., 2021; Westwood et al., 2020). Westwood et al. focused on the consequences of misinterpreting projections in predictive journalism articles on demobilizing the public in election forecasts (2020). In the context of COVID, Pentzold et al. looked at how predictive models in the news were presented and discussed in news products and whether such models did a good job casting away uncertainty and ambiguity around COVID-19 (2021). Moving beyond these prior studies, the present research focuses on describing the public response to predictive models covering the COVID-19 pandemic by elaborating themes that reflect the types of responses found in online news comments.

**Methods**

In this section, we describe the data collection and analytic approach to the qualitative analysis of the comments section of news articles published in three news outlets: The New York Times, The Washington Post, and FiveThirtyEight.

**Data**

Our data here consist of news comments made in response to predictive journalism articles about COVID-19. We chose to focus on news comments as they contribute to the deliberative public discourse and offer a rich stream of data for understanding public reactions (Eisele et al., 2022; Lee and McElroy, 2019). At the same time, comments do not reflect all news readers (Friemel and Dötsch, 2015), and therefore, our analysis of comments should not be interpreted as some reflection of public opinion or the general population but rather reflects only the population of commenters studied. Although there are sometimes issues with the quality of news comments (Santana, 2014) including issues of incivility, hate speech, and rude language (Coe et al., 2014; Hughey and Daniels, 2013), prior research has shown that people tend to conform to standards of thoughtfulness set by others in online commenting communities (Han and Brazeal, 2015; Sukumaran et al., 2011). In addition, in comparison to comments on social media, research has found that comments on news websites have more deliberative quality than those on social
media outlets (Rowe, 2015). As our results here show, we did not encounter substantive quality issues with the data we collected.

To construct our dataset, we draw on a corpus of previously collected news articles that incorporate predictive information (Diakopoulos, 2022) and identify a subset related to COVID-19, which could be in the present or the future (e.g. projecting the number of COVID-19 cases next month). We specifically sought articles related to COVID-19 that showed evidence of some computational technique (i.e. a model that can predict a value, score, or category) or computer simulation. A total of 27 articles were identified, coming from various sources including: The New York Times (11), The Economist (6), Washington Post (3), NPR (2), Time (2), Bloomberg (1), FiveThirtyEight (1), and Reuters (1). Articles that did not have a comment section or did not allow readers to comment on the article were excluded from further analysis. Accordingly, only six articles remained, three articles from The New York Times, two articles from the Washington Post, and one article from FiveThirtyEight that fit the search criteria and enabled readers to comment. All six articles were published between 19 February 2020 and 28 May 2021 at a time when the world was still learning about the virus and vaccine efficacy (Table 1).

All of the articles in our dataset followed a relatively similar structure where journalists pose a question related to COVID-19 that is relevant to the public, then attempt to answer this question using either computer simulations, mathematical, or epidemiological models that convey to the public possible future outcomes. For example, on 13 March 2020, 2 days after the declaration of COVID-19 as a global pandemic by the WHO and prior to any public conversation about rolling out the vaccine, Nicholas Kristof and Stuart Thompson published in collaboration with infectious disease epidemiologists an online opinion article titled “How Much Worse the Coronavirus Could Get, in Charts.” The discourse in this article was mainly focusing on potential policies and actions that could help in curbing the number of infections due to COVID-19. The article showcases an interactive simulation tool that allows readers to visualize how swift actions by U.S officials could make a difference in controlling the pandemic. The interactive tool starts by displaying simulated numbers of COVID-19 infections and fatalities in the United States from April 2020 until July 2021 if no action was taken by U.S officials to control the pandemic (Figure 1a). As the reader scrolls down through the article, different scenarios were displayed to demonstrate that implementing interventions is not only important, but the timing and immediacy of when these interventions are implemented could have consequences on the number of infections and fatalities. For example, based on results from the interactive tool for one of the shown scenarios, implementing intervention measures (e.g. ending public gatherings, closing workplaces and schools, and mass testing) as early as June 2020 could reduce the number of infections in July 2020 from 9.4 million, if no action was taken, to 4.5 million cases and reduce the number of fatalities from 1 million, if no action was taken, to 475,000 deaths by July 2021 (Figure 1b). Readers can modify the timing and level of aggressiveness in implementing additional measures to better understand the impact of these factors on the course of the pandemic (Figure 2).

Next, we used The New York Times API to collect online news comments for all articles in our sample that are published on the New York Times website. For the
### Table 1.
Articles used in the data analysis, the date those articles were published on, their source, and the number of comments analyzed from each article.

| Title                                                                 | Date Published   | Source                      | Number of Comments Analyzed |
|-----------------------------------------------------------------------|------------------|-----------------------------|-----------------------------|
| How epidemics like COVID-19 end (and how to end them faster)          | 19 February 2020 | The Washington Post         | 56                          |
| How Much Worse the Coronavirus Could Get, in Charts                   | 13 March 2020    | The New York Times          | 341                         |
| What 5 Coronavirus Models Say the Next Month Will Look Like           | 22 April 2020    | The New York Times          | 223                         |
| How a sluggish vaccination program could delay a return to normal     | 9 February 2021  | The Washington Post         | 109                         |
| and invite vaccine-resistant variants to emerge                       |                  |                             |                             |
| Just How Big Could India’s True Covid Toll Be?                       | 25 May 2021      | The New York Times          | 39                          |
| Where The Latest COVID-19 Models Think We’re Headed—And Why They Disagree | 28 May 2021      | FiveThirtyEight             | 117                         |
Figure 1. (a) and (b) Predictions generated by the model developed at the New York Times. (a) The predicted number of infections and total deaths due to COVID if no intervention or action is taken. (b) The relationship between early interventions and the model's forecasts and the impact of early interventions on the forecasted number of infections and total deaths.
Figure 2. Illustrates how the audience can interact with the model by changing when interventions can begin and their level of severity. There are three levels of severity that the model accounted for: mild, moderate, and aggressive. The audience can visualize the impact of each level of intervention severity on the number of infections and total deaths due to COVID.
remaining news sources, we used a custom web scraper to scrape the comments section of the Washington Post and FiveThirtyEight articles. A total of 1851 comments were collected, 1239 comments from articles published in The New York Times, 328 comments from articles published in the Washington Post, and 284 comments from FiveThirtyEight. Since we were only interested in understanding the direct public response to predictive information in these articles, and not commenters’ responses to each other’s comments, we excluded comment replies (i.e. comments to other readers’ comments) before conducting our analysis. Out of the 1851 comments originally collected, only 885 direct comments were left for analysis (603 comments from The New York Times, 165 comments from the Washington Post, and 117 comments from FiveThirtyEight). A small subset of uninformative comments were further excluded from the analysis because they were lacking clear relevance to the article (e.g. “Trends are your friends”). In the end, the remaining comments did not exhibit the quality issues sometimes observed in online news comments (Santana, 2014) but rather reflected an overall courteous (i.e. not rude, obscene, or trolling) discourse.

Analysis

All of the collected comments were analyzed using a qualitative thematic analysis approach (Braun and Clarke, 2006). The authors started with the earliest published article to sequentially open code all comments. The objective was to allow themes to emerge from the data while following the method of constant comparison to continuously assess the fit and organization of comments into stable conceptual groupings across comments. To code the comments, the authors read comments while summarizing and pulling excerpts that could be grouped together to fit into an evolving set of possible thematic clusters of comments or potentially be the basis for new themes. Throughout the coding process, the authors wrote memos to articulate and clarify the evolving definitions of concepts that the themes represent. The authors also periodically discussed and assessed the conceptual organization of themes, a process often referred to as analyst triangulation (Patton, 2014). This contributed to the refinement of the overall organization of the emerging themes. Per the constant comparison process in qualitative research, all emerging themes and their definitions were continuously revised and assessed throughout the coding process to ensure that the themes made conceptual sense and decide whether they needed to be reorganized, merged, or further broken into more themes (Strauss and Corbin, 1990). After coding 768 comments on five articles, the themes were largely saturated and stable with small amounts of new information still being added depending on the specific context of the article being coded. However, this new information did not require any reorganization or revisions of the concepts that defined the saturated themes. To be sure that the authors reached a suitable level of thematic saturation, an additional article from the list of sampled articles (described in Table 1), titled “Where The Latest COVID-19 Models Think We’re Headed—And Why They Disagree,” was coded bringing the total number of coded comments to 885. The newly coded comments did not contribute to the formation of new themes or necessitate the revision of the conceptual organization of themes, but rather supported the already existing themes and how they were organized.
As a qualitative analysis, we focus our results on describing and elaborating themes rather than on considering the salience or prevalence of those themes.

Results

Throughout the qualitative thematic analysis of the comments, we found that the focal point of readers' comments was on the models described in the sampled articles. All emerging themes resulting from the qualitative thematic analysis were also descriptive of the attitudinal responses to the models in the sampled predictive journalism articles in the context of the pandemic. In the following subsections, we describe the three themes and corresponding subthemes and codes, which are also summarized in Figure 3.

Affective response

All comments that include clear expressions of negative emotional responses after interpreting the models described in the sampled predictive journalism articles were grouped under the broad affective response theme. Comments in this theme conveyed rising levels of concern about the future of the virus. Predominantly, comments consistently expressed fear as one of the emotions triggered by the models’ depictions and forecasts of the worst-case scenario (e.g. “the worst-case scenario [as described in the model] does nothing but promote anxiety and fear”). Such comments were grouped into a single subtheme named negative emotional response. Throughout the qualitative analysis of the comments, we also observed a few commenters communicating other types of emotions such as anxiety, nervousness, and frustration in response to the models. For instance, one commenter wrote, “I don’t find articles like these helpful; it just accelerates anxiety and panic” and another stated that “Every evening I get into a state of fear and frustration when I come here to see the updates [of the model].”

Another observation we found in readers’ comments is their utilization of the model to mentally simulate future events about the possible trends of COVID. This, however, could yield a worrying perspective and negative sentiment about the future as one commenter puts it “There is no way to eradicate this virus and other viruses. Everybody will be afraid to engage in sports, travel and even work. Life as we know has been dramatically diminished forever.” Even in the presence of optimistic news such as the vaccine development, readers expressed their negative outlook of the future outcome of COVID based on their interpretation of the models “I think a vaccine is at least a year away and that is super optimistic. By then, Covid might well have run its course, killing millions.” Other commenters used information from the models to compare it to the present state of the virus at the time. This mental process could have created negative emotions and perception of the uncertain future as readers interpreted results of the model. For example, a commenter in their seventies shared: “all outcomes are uncertain and trend towards the dire, towards the non flattened curve on your chart [referring to the model]. My husband and I are both in our seventies. We’re not panicking, but are definitely afraid.”

Negative emotions evoked by interpreting the models, as shown in the previous examples, were also in some instances a catalyst for readers to take action. This was evident in a comment shared by a teacher in a community college discussing the shift to
Figure 3. Typology of responses to predictive journalism articles grouped by the three main themes (shaded in dark gray) and their corresponding sub-themes (shaded in light gray) and codes constituting those themes (white).
online learning due to their concern about safety: “I work at a rural community college. These charts [referring to the model] make it look like the entire summer, fall, and even next spring might be too unsafe, resulting in maybe a year or more of online instruction.” In the next section, we will further elaborate on this type of action-oriented response by focusing on the numerous actions that were taken or demanded by the readers as expressed in their comments.

**Action-oriented response**

Action-oriented response is the main theme which amasses all comments requesting or demanding action as a result of understanding and interpreting the models; as one comment illustrates, “The model easily understandable and illustrates the impact of practical changes in our behavior on the peak severity and cumulative fatalities, The good news is that an aggressive approach can save thousands of lives. Lets get underway today!” Throughout the qualitative analysis of readers’ comments that gave rise to this theme, commenters were encouraging domestic (i.e. government, collective society, or individual/personal) and global (i.e. global community) actors to take political, economic, or health-related actions.

In the action-oriented response theme, commenters referenced the model in their comments to justify when, why, and by whom an action needs to be taken to curb the spread of the virus. For example, commenters ascribed to the government the task of implementing aggressive measures as early as possible to slow down the spread of the virus, one commenter wrote “As shown on the graphs very early intervention is absolutely essential. Everything possible to do must be done if that means closing schools, public gatherings, etc..” Other commenters also proposed that society should take the necessary measures moving forward to avoid infecting more people. For example, a commenter suggests, “Great article and the model helps to explain what is going on. Work from home if you can. Clean your hands-a lot. Go out just once a day, if needed, to get supplies.” It is worth noting that irrespective of the type of ascribed responsibility or action, models in the sampled predictive journalism articles remain the main focal point of the comments requesting to take action in response to the pandemic.

Next, we elaborate on the types of actions commenters ascribed to domestic and global actors.

Our analysis revealed three main types of actions referenced in readers’ comments: political, economic, and health-related actions. Political actions are best described in terms of comments requesting actions that are political in nature such as voting the president out (e.g. “Call them out on it . . . and vote them out on it.”) or calling for collective action (e.g. “It’s up to the people to organize and demand action”). Economic actions include comments calling for the distribution of economic relief packages to support individuals, families, and businesses impacted by the virus (e.g. “$1000 a month would go a long way to helping millions of Americans who will lose their jobs in the coming months from an economy grinding to a halt.”). Finally, health-related actions were expressed through comments encouraging the adoption of health measures on the individual or societal levels, such as social distancing, to slow down the rising number of COVID-19 cases and protect vulnerable groups in the medical profession (e.g. “social
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distancing will matter greatly to avoid the peak happening too quickly. Let’s do all we can to flatten the curve, to care for the high risk and our medical professionals.

All actions were ascribed to either domestic or global actors. On the domestic level, actions were ascribed to either the government, collective society, or individual (or personal) actors. Comments ascribing actions and responsibility to the government are requesting actions to be taken by the state or federal governments in response to the virus. Examples of actions include, but are not limited to, increasing testing capabilities as one commenter stated, “Our nation does not have testing kits available for everyone. We need multiple tests for each person in America.” Another action that was requested in the comments in the form of a suggestion is to reopen closed military facilities as hospitals to treat infected individuals, “Beyond increased testing, what is being done to expand capacity to support the surge in hospitalizations? Build new hospitals in 10 days as China did? Reopen closed military facilities to quarantine infected individuals?” In addition, some comments were also demanding further clarification on health strategies to handle COVID as one commenter puts it, “. . . I don’t disagree with the current strategies, but I would like to hear CDC epidemiologists give modeling updates frequently and not just tell us what to do, but keep explaining why”.

Commenters also ascribed actions to collective society by using collective language and terminology (e.g. “we,” “American public,” “us”) to request and encourage the public to take precautionary measures in response to the virus. For example, one commenter encouraged the public to comply with the recommended aggressive measures of social distancing as stated in their comment: “We all have to concentrate on social distancing and hand washing”. In another example, a commenter encouraged others to wear masks in public “Once more vaccines are approved, things will change for the better. Until then, wear a real mask, practice social distancing and the virus will have a tough time jumping around”. Other comments ascribed actions on the Individual or Personal level. This was evident from a group of comments expressing actions that will and should be taken by commenters on the individual or family levels to minimize the spread of the virus. After reviewing the models, some commenters, for example, were “persuaded to lay low and not to visit their elderly parents over spring break”. Others chose to take extra health precautions by “wearing a mask and gloves and washing hands for a very long time”.

On the global level, comments ascribing responsibility to the global or international community were grouped under the global community actor group category. Comments were encouraging global altruism in vaccination initiatives to increase vaccination rates around the world (e.g. “. . . The entire world must help the entire world get vaccinated”). In addition, commenters were also concerned about the moral implications pertaining to vaccine inequity as privileged countries produced and purchased more vaccines than less privileged countries. One commenter writes in that regard, “I am concerned about rich countries buying up vaccines and smaller, less rich countries trying to compete for those vaccines. Ignoring the moral implications, this is not be good for our world.”

Overall, action-oriented responses can be thought of in terms of a matrix of actors and actions. In our analysis of users’ comments, we found the list of actors to include the government, society, individual/or personal actors, and the global (or international) community. We also identified political, economic, and health-related types of actions to be associated with the aforementioned actors. Despite our findings, we expect the list of
actors and actions to expand depending on the context of future research. In the next section, we shed light on the remaining group of comments concerning readers’ evaluations of the models.

**Evaluative response**

This theme encompasses all the remaining comments consisting of supportive and critical responses resulting from evaluating the models. Supportive comments were grouped into three subthemes: *supporting predictive journalism, model enhancements*, and *illustrating modeling principles*. In contrast, *Critical Comments* were criticizing the models and the way models were visualized and presented (*visualizations*). Throughout the thematic analysis, we also found a few instances of critical comments being directed toward other entities (e.g. *healthcare system*), and actors (e.g. *government, the public, and journalists*).

Supportive comments in the *supporting predictive journalism* sub-theme were complementing the analyses and models that journalists have put together. Some readers expressed their appreciation for the ease of accessibility and understanding of the models, one reader commented: “Thank you very much for this animated graphic. It really makes the science behind epidemics much easier for us lay people to understand”. According to another group of commenters, models seem to have clarified information about the virus, another commenter wrote: “Great! Curves like these act as a kind of armature that give a rough idea of the form of the beast we face. Again, great!”. Also, readers complemented the journalistic efforts sharing models that are informative of the primary role of interventions in responding to the virus, “This was the sort of analysis that was needed to explain what and when things needed to be done. Thank you”. In a few instances, commenters also complimented the models for giving them an insight into the impact of the virus in other countries, a reader commented: “This is a great mathematical projection of what is actually going on in India. The saddest part is so many lives could have been saved if the authorities had been prepared with proper medical stockpiles”.

In the *model enhancements* subtheme, comments included several suggestions to improve the models such as assessing the performance and accuracy of the models (e.g. “it would be interesting to compare the past predictions of each model to the actual death count.”). Other suggestions include requests to account for additional assumptions that were not considered during the model development process (e.g. “It doesn’t seem these models take into account the potential for new infections in the vast re-opening that is planned in certain states. They should show that effect estimated”). Commenters also suggested developing additional models that “takes into account the impacts of mutation of coronavirus and potential reinfection rates.” A few other comments were relevant to the user experience of the readers as they read through the results of static (i.e. noninteractive) models. For example, a commenter suggested for journalists to give readers the ability to engage with the models: “It’d be great if the designers let the readers use this tool.”

As for the *illustrating modeling principles* subtheme, in some instances, comments described how models work (e.g. “Models are not static and continually get refined with
more data. Most models have assumptions. All models have uncertainty”). In other instances, comments clarified the assumptions made in the process of making predictions, one commenter elaborates:

Models don’t know the future outright – what people do matters and they try to adjust to those changes. Think of it this way: the models that predict deaths are going to decrease assume we will be sheltering-in-place for longer, while models that predict the number of deaths will increase assume shelter-in-place will be lifted. Models extrapolate from trends—they don’t predict policy decisions.

In addition, commenters shared information on how a model’s performance can be assessed through the quality of its predictions in comparison to observed outcomes, “There is bound to be an error epsilon between the real deaths and those predicted by the model.”

Criticism in the critical comments sub-theme was being mainly directed toward the models with a few other instances of it being directed at entities and actors. Comments criticized the models for their poor performance due to the lack of testing data incorporated into the models (e.g. “Garbage in, garbage out. Until we test enough, we’re just guessing.”) or the bias they may introduce among researchers aiming to understand how the virus is spreading (e.g. “These models limit a researcher’s ability to see how the data develops. they channel the researcher into seeing if the data fits the model instead of if the data fits the theory. I know this sounds abstract but it is a genuine worry”). The over-optimism in some models’ predictions was also criticized by commenters as shown in this comment:

I looked back at IHME forecast in March. It predicted 1,500 deaths in CA by end of August. We passed 2000 in April. Even now it predicts we will be done with deaths by May 19 or so. The model is far too optimistic.

In addition, a small subset of commenters uniquely focused their criticism on the way models were presented and visualized. For example, one of the comments criticized the aesthetics of a graphical plot displaying multiple line charts in a single chart, the commenter wrote: “I’m sorry I don’t understand these charts. I’m confused as to where each one starts.” In another example, a commenter also criticized the visualizations for being too difficult to interpret, the commenter wrote: “More clarity would be nice, I’m a science guy and I struggled to understand what was being shown.”

The remaining collection of critical comments were directing criticism to entities such as the healthcare system that commenters think should have taken more responsible actions in response to the pandemic. Specifically, in the context of the lack of accessibility to COVID testing, one physician wrote: “As a physician, I am appalled at the delivery system for valid coronavirus tests in comparison to competent medical systems like South Korea who have rapid-result and drive-through testing.” Other comments focused on the sluggish vaccine distribution process, one commenter complained: “Most vaccination centers have little if any vaccine stocks, opening more will not help unless vaccines can be sent to them by the hundreds of millions.”
Government entities were also the subject of criticism in the comments. The executive branch of the government was criticized for its poor leadership and inaction in response to the virus, a commenter wrote “Yet the schools are still open. Just the kind of leadership and vision that we’ve come to expect.” The Centers for Disease Control and Prevention (CDC) was also criticized after it decides to revoke the masking rules for vaccinated individuals as stated in one of the comments: “CDC says no masking needed for the vaccinated. what a joke?! this is what you get when everything is politicalized in US.” Commenters also criticized a segment of the public for disregarding the dangers of spreading the virus during travel. One commenter expressed the problem by criticizing “the people who are infected while traveling are ignoring the fact that they are spreading the disease by returning home.” Furthermore, some commenters were critical of people in society dismissing the information presented in the models, “It makes me nuts reading people dismiss the models as irrelevant simply because they are imperfect”—one commenter wrote.

In contrast to the comments in the supporting predictive journalism subtheme of support comments, there were a handful of comments in the critical comments theme that focused their criticism on journalists and the models they have developed. For example, one commenter thinks that journalists “should be out volunteering instead of complaining and whining [about rising cases due to the virus].” Another commenter found “a remarkable lack of actual substance” in the models and therefore decided to “tune them out as distraction.”

All supportive comments in the evaluative response theme were either complementing the journalistic effort put forth by journalists, explaining how modeling works, or providing recommendations and suggestions to enhance the models. Critical comments, however, were predominantly focusing on criticizing the models with a few instances of comments directing criticism to other entities as stated earlier.

**Discussion**

In addressing the research question of how the public responded to COVID predictions in the news media, this research elaborates three main types of public responses (affective, action-oriented, and evaluative as well as several subthemes of those types) that we observed in the online news comments to articles of predictive journalism related to the COVID pandemic. This richly described typology of responses offers a contribution insofar as it nuances the ways through which predictive information is processed and could indeed impact cognition or behavior, suggesting routes through which the misinterpretation of predictions in news media (Gelman et al., 2020; Westwood et al., 2020) could be activated. Moreover, the typology offers fertile ground for researchers to further explore and validate these types of audience responses, operationalize them for potential quantitative or computational analysis at a larger scale, and expand and validate them in other contexts such as in political, economic, or climate forecasts. Studying the range of public response to predictive journalism is a necessary first step toward understanding how journalistic practice might also adapt to avoid misinforming the public, biasing its opinion, or discourage it from civic participation. In the following subsections, we further discuss implications for research and practice that emerge from our synthesis of the response types.
The role of affect in future-oriented cognition

The intolerance of uncertainty about the future paired with the fear of COVID-19 appears to have an effect on peoples’ mental well-being (Satici et al., 2022). The affective response theme surfaced some of the negative emotions attributed to the pandemic that are in line with recent research (Coelho et al., 2020; Mertens et al., 2020). Although our findings in this theme reflect readers’ fear and anxiety about the future, we suggest that researchers should explore whether predictive journalism could also have the capacity of eliciting prosocial emotions, such as empathy, that could motivate cooperation in collective acts, especially during crises (e.g. motivating the public to wear a mask during the COVID pandemic as a precautionary measure to protect the elderly). In contrast, misinterpreting predictive journalism articles could elicit negative emotions, such as anger, that may divide the public and mobilize it toward hostile action.

Our findings also suggest the need to consider the public’s affective response to the models as a feedback system that stimulates retrospective appraisal of previous actions, and possibly alters future behavior (Baumeister et al., 2007). For example, if someone is fearful due to interpreting the model, this emotion can stimulate the thought of previous actions that should have been taken and possibly inform future behavior. In light of this, it might be worth exploring whether public emotionality mediates the possible effect of predictive journalism on informing readers’ judgments and decisions or motivating their actions with respect to the future. Given that affect can drive planning and eventual action (Seligman et al., 2016), it seems crucial that future work engage deeply with the affective response to predictive journalism. This is aligned with the recently termed “emotional turn” in journalism studies—a growing area of research in journalism in the past decade that recognizes the importance of emotion as a prism to understand social and political life which suggests an agenda for research on how emotions and journalism intersect (Wahl-Jorgensen and Pantti, 2021).

Responsibility assignment for future actions

In the action-oriented response theme, we identified an interesting pattern in readers’ comments that tend to ascribe responsibilities and actions to different actors. Commenters even outlined actions that can and must be taken in response to the pandemic by different actors in society, government, and the international community on the global level. In a sense, commenters were engaged in a group planning activity where particular actions and responsibilities are articulated for future action. Summarizing such group planning, including using other feedback signals on comments such as “likes,” could be a powerful way to harness the collective future-oriented cognition (Szpunar et al., 2014) of a community to both suggest and evaluate what to do.

The notion of responsibility assignment also raises the broader question about the function of predictive journalism in society, especially with respect to mobilizing the public toward social issues or in crises when there is very little known about the future. Prior research by Yanovitzky and Weber (2019) theorized the effects of news media on policy actors and subsequently on policy making where they outlined mobilization as one of the core knowledge-brokering functions of news media. Appelgren and Jönsson
(2021) also found that the merger between science communication and data journalistic practices coupled with motivational framing were effective in increasing public engagement with climate change. Accordingly, it is vital to deeply understand why and how the framing of forecasts outlined in predictive journalism articles may encourage the public to conduct a responsibility analysis of who is responsible for what, who needs to do what, and when. Future work on predictive journalism should consider focusing on understanding how the design and presentation of predictions could positively shape and channel collective activities to increase citizen engagement and willingness to take action on issues related to social and climate justice.

Harnessing responses for improved communication

Overall, commenters expressed the significance of predictive journalism by thanking journalists for their efforts in covering the pandemic and complementing the models attempting to cast away the uncertainty about the future. Additional supportive comments came in the form of suggestions such as enhancing the predictive power of the models (Diakopoulos and Naaman, 2011; Henrich and Holmes, 2013). Despite this supportive sentiment, other comments criticized the models and the way they were visualized. Practitioners may find some of these comments helpful in developing new communication tools (Kay, 2022) or shaping best practices that data journalists could follow to achieve simplicity and clarity in visualizing forecasts and scientific data.

The critical comments subtheme in the evaluative response theme further highlights the importance of introducing novel qualitative and quantitative methods that capture and assess the accuracy in public understanding of statistical and scientific visualizations in the news to avoid possible misinterpretations of facts or forecasts on the public level (Secko et al., 2011). Although our findings in the illustrating modeling principles sub-theme show examples of commenter-led initiatives to educate others about basic modeling principles such as model assumptions, model interpretation, and model performance evaluation, we think that this inclination could be more explicitly shaped and encouraged through journalistic initiatives similar to the New York Times “What is Going on in this Graph?” that grants students and readers the online space to develop their data-literacy skills through discussing and interpreting visualizations as a group.

Conclusion

Predictive journalism offers the public the ability to explore possible future scenarios on topics that are relevant to society and help them comprehend uncertainties about the future. In this research, online news comments enabled us to understand audiences’ responses to COVID models in the news and more broadly to the emerging genre of predictive journalism. Specifically, this research is a step toward examining how this genre of journalism impacts the public’s emotions, behaviors, and future thinking. We elaborate a discussion examining the role of affect in future-oriented cognition around media, the notion of collective responsibility assignment which may have implications for how groups plan the future or think about accountability for failure, and the idea of leveraging comment responses for improving communication of predictions. Based on
our findings, we propose future research directions around deepening our understanding of the role of predictive journalism in shaping public opinion especially with respect to future decisions on policies for a variety of social and political issues. In particular, survey methods could also be developed to further understand audience responses to predictive journalism, especially given that not all articles have comments. The typology presented in this work opens up space for future research to validate it, operationalize it for quantitative study, and extend it to study it in other exceeding important domains such as election and climate forecasting.

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Notes

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