



SCIENCE IN A TIME OF CRISIS: COMMUNICATION, ENGAGEMENT AND THE LIVED EXPERIENCE OF THE COVID-19 PANDEMIC

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SCIENCE IN A TIME OF CRISIS: COMMUNICATION, ENGAGEMENT AND THE LIVED EXPERIENCE OF THE COVID-19 PANDEMIC

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Editorial: Science in a Time of Crisis: Communication, Engagement and the Lived Experience of the COVID-19 Pandemic

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Editorial on the Research Topic

Science in a Time of Crisis: Communication, Engagement and the Lived Experience of the COVID-19 Pandemic

When we opened the call for this Research Topic in the summer of 2020, we never imagined that nearly 2 years later, we would be nearing 500 Million COVID cases worldwide, still debating COVID restrictions, continuing to argue about vaccine mandates, and wondering when or even if we'll see a final coronavirus surge or variant. The editors of this Research Topic have shared experiences, including multiple national lockdowns, quarantines due to exposure, or potential exposure. We have experienced separation from family and friends during times of love and loss and we have seen the rise of physical violence as a response to restrictions, which we have never witnessed before. In other ways, our lived experiences reflect the diversity of the countries where we live, with divergent political discourse about science and risk, different local/national mask requirements or bans, and diverse responses to COVID vaccines.

The articles in this Research Topic also reflect a diversity of experiences and a diversity of epistemological, theoretical, and methodological approaches, ranging from discourse analysis (Fernandes) to surveys (Motoki et al.) and from experimental research (Anderson and Sivakumar) to content analysis (Massarani and Neves). This collection emphasizes different domains of research and science communication practice, including the rhetoric of scientific communication (Schneider), public participation/democratic decision making (Prettner et al.), media and science journalism (Davies; Massarani and Neves; Oliveira et al.), risk perceptions and uncertainty (Anderson and Sivakumar; Fernandes), and scientific literacy (Motoki et al.). Taken together, the goal of this Research Topic is to contribute to the literature on social dimensions of COVID-19 by examining how communication relates to attitudes, practices, and values at critical times of high risk, high stakes, and prolonged uncertainty (Funtowicz and Ravetz, 1993).

In many ways this collection of articles also underlines the challenge of analyzing wicked problems in the making. This collection offer insights gathered at a specific moment in time, i.e., in the early phase of the pandemic, and the sense that researchers made of that moment of uncertainty, evolving risk, and confusion. These papers were written at a time when knowledge about the virus

was only beginning to emerge, when the vaccine was more a hope than a reality, and when most people thought of the COVID crisis as an episode rather than a long moment in our history. As a result, this collection offers both a careful analysis of the specific communicative situation indicative of the early phase of the pandemic and a way to reflect back on how, we as researchers, used specific framings and tacit assumptions when doing our analysis. Moreover, this collection offers a chance for us to learn and reflect on how difficult it is to develop adequate and effective responses to a global health crisis. The case of vaccines is a good example of how challenges emerged and evolved. In the early phase, the development of the vaccine was framed positively and appeared to generate hope; yet once in place, we saw the emergence of debates on vaccination mandates, concerns about vaccine efficacy, and uncertainty about the very status of the vaccine. Also, at least in the European context, while the call for expert-based policy making was loud in the early phase, uncertainty, complexity, and divergence dominates public debate today.

At the outset of the pandemic, we were hopeful, as Fearon et al. (2020) suggested, that this “pivotal moment for trust in science” would not be wasted. We wondered if the pandemic would be a bridging event; one that encouraged a new wave of social unity, focused on protecting human lives and building community. We expected the pandemic to contribute to heightened public attention on science and science policy. Indeed, prominent medical researchers, such as Dr. Maria Van Kerkhove (WHO) and Dr. Anthony Fauci (CDC), as well as many others in different national contexts, received considerable media attention throughout the pandemic. We hoped that increased attention on the role of science and medical research during the pandemic might provide opportunities to facilitate a greater connection between the public and scientists, encouraging a revival of public support for and engagement with science during a global crisis. A recent report by the Wellcome Global Monitor, based on a survey of more than 119,000 people in 113 countries, suggests that trust in science and scientists increased from 2018 to 2020 (Gallup, 2020). Yet the rise in trust was uneven, with greater increases among individuals with little self-reported knowledge of science and those with greater confidence in their national government (Gallup, 2020). Like these results, cases in this Research Topic emphasize the incredible complexity of responses to science and scientists during a global pandemic; highlight ways in which the connection between scientists and the public is mediated by political leaders and the media; and affirm that the role of science in society remains contested ground, shaped by divergent cultural and political perspectives.

“Citizens have a stake in the scientific advice that translates into policies” because the outcomes of these policies “directly affect their lives” (Prettner et al., results, para 4). Despite calls for citizen involvement in policy making and a robust body of scholarship and practice on public engagement in science, articles in this Research Topic suggest that government outreach and scientific communication about COVID, particularly in the U.S., the U.K., and Europe, were dominated by top-down, technocratic messaging strategies in the early phase of the COVID crisis. The technocratic approach generally

prioritizes scientific expertise, establishing science as the basis/justification for policy decisions. For example, Prettner et al. cited multiple claims and statements made by the Dutch Prime minister and other representatives of the Dutch government presenting experts as reliable, trustworthy sources of information and thus, the “right” group to make decisions and suggest solutions to the COVID pandemic. This framing often portrayed experts as deserving of “blind faith,” and as the COVID pandemic went on much longer than expected, this framing became the locus of highest contestation across many countries.

The implications and limitations of this adherence to technoscientific framing for public understanding was also explored in this Research Topic. Beall et al. found that among U.S. respondents, technoscientific framing increased the perceived validity of a scientific study for conservatives and lowered the validity for liberals. While technoscientific framing was only slightly effective in increasing the perceived validity of scientific findings, regulatory framing had no effect. The “staging of science” by the Dutch government, including their exclusionary approach to political deliberations and scientific discussions (i.e., not publishing transcripts or sharing meeting minutes) contributed to public criticism and perceptions of a secretive elite (Prettner et al.). Relying on diagnostic and prognostic framing, Prettner et al. demonstrate how the Dutch government’s emphasis on science was widely questioned, challenged, and contested on social media. Anderson and Sivakumar examined the relationship between trust in government agencies and individual interpretations of risk, finding that efforts to downplay risk increased perceived risks among individuals who trust government agencies. This finding highlights the complexities inherent in communicating trustworthiness and building or repairing trust during a crisis event.

Highlighting the complexity of a one-size-fits all approach and the diversity of responses we described at the top of this editorial, there were also differences in the use and application of technoscientific-framing across countries. Massarani and Neves documented greater reliance on the technoscientific approach in the U.S. and the UK compared to an emphasis on political frames, manipulation, and distortion of information in Brazil. Oliveira et al. present evidence of strong criticisms of scientific claims and health institutions’ recommendations by the Brazilian political elite, including President Jair Bolsonaro and his son. Thus, in this case, scientific sources used technoscientific framing to refute statements made by prominent political actors. These studies illustrate the crucial role of political leaders and their ideologies in the dynamics of communication on COVID-19.

Within this Research Topic, social media emerged as a key space for critical engagement, resistance, and contestation of science, politics, and social action. Politicians, academics, science communicators, and citizens took to Twitter and other social media sites to learn, to document individual and collective experiences, to make sense of what was happening, and to refute others’ claims (Davies; Oliveira et al.; Prettner et al.). YouTube and other online video platforms were popular places to go to see videos of protests, tributes to health workers, and watch question-and-answer sessions about COVID, local

policies, and/or how to make a mask out of a cotton t-shirt (Oliveira et al.; Schneider). Academia and academic life were also performed through social media during the COVID crisis. Davies highlights scholars' use of social media networks and technologies to document their experiences of disruption, express care for others, seek support or advice, and to critique inequity and injustice within and outside of academia.

Scholarship on legacy media, especially newspapers, is heavily represented in several pieces in this Research Topic (Delicado and Rowland; Fernandes; Massarani and Neves; Oliveira et al.). In some instances COVID-19 coverage gave journalism a new breath of life as in many countries there was an increase in citizens' trust in conventional media sources, especially "quality" media outlets (Gallup, 2020). This adds to the social responsibility of legacy media in reporting scientific knowledge and its limits; in creating images of scientists; in examining science's social contexts, contingencies and constraints; and in bridging the science-policy nexus. The COVID pandemic has also posed new challenges and ethical questions for journalism: for instance, in the midst of an unprecedented public health emergency, how does news coverage shape public images of science? how can journalists address scientific uncertainty and risk and what happens when they do? Delicado and Rowland examined more than 600 images, many from newspapers in Portugal and Spain, to evaluate representations of science early in the pandemic. Their findings suggest that newspaper images were more eclectic than those curated for government websites. Most of the images they identified relied on stereotypes of science performed at a laboratory bench and confined to a test tube. While the images of scientists were egalitarian in terms of gender, the authors note a lack of ethnic diversity in published visual representations of scientists.

Scientific uncertainty and the framing of uncertainty by scientists and government representatives was at the core of several articles in this Research Topic. In this collection, Fernandes shows how media can discursively reconstruct scientific uncertainty and scientific error in different ways. Prettner et al.'s paper suggests that the Dutch government's framing of uncertainty evolved over the course of the pandemic, shifting from something that necessitated expert advice and control, to a factor external to expert advice, to an unavoidable force that affected expert advice and government decisions. Thus, it is not only the legacy media that reconstruct uncertainty and define it in myriad, sometimes contradictory, ways. The expert profiled in Schneider's article also normalizes the acknowledgment of uncertainty and change. This is an approach often encouraged by scholars and practitioners of risk communication (Lundgren and McMakin, 2018), but rarely exhibited by experts, likely related to the aforementioned adherence to the technoscientific approach to communication. This tension, between presenting scientists as knowledgeable experts and the need to understand and admit that scientific

expertise evolves over time, opens up important questions for future research: How can scientists remain credible and legitimate while embracing uncertainty? How do technoscientific messages that highlight different forms of uncertainty influence public perceptions of science and scientific recommendations?

Except for Brazil, all the cases studied in this Research Topic are part of the Global North. Although several Northern countries were badly affected by the pandemic, other world regions also suffered enormously and yet these regions have received less attention from media and from scholars of science and risk communication. Understanding how public health policies, communication practices and public engagement played out in India, Mexico and South Africa, but also in the different Asian countries (see current crisis in Shanghai in 2022 due to the strict zero-COVID policy and related lock-downs; or COVID around the Olympic games), is a vital task for future studies on communication. This effort would complement cross-national studies of COVID policy responses (see for example, Jasanoff et al., 2021) and highlight and develop messaging and engagement strategies that span multiple cultural perspectives and realities. Oliveira et al.'s article and many other in this Research Topic highlight the continued "monopoly of information, in the hands of the few" and most of the articles highlighted elite voices and concerns. These patterns stress the need for scholars like us, in the fields of science and risk communication, to broaden our lens beyond elite groups in an effort to mitigate existing inequalities and democratize the potential impact of our work.

As we close this Research Topic, there remain important opportunities for additional research on the barriers to inclusive and diverse representations of science and scientists in media and society and the innovative use of social networks and web-based media platforms to shape and challenge cultural symbols of academia and institutionalized inequalities. Likewise, the future of science communication practice, in the media and elsewhere, will continue to be influenced by the losses, experiences, insights, and challenges that the pandemic created. Identifying, analyzing and understanding these impacts will remain a key task for communication research and practice.

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DW, AC, and UF contributed equally to the conceptualization of this manuscript. The authors contributed to the writing of this article in the order they are presented. All authors contributed to the article and approved the submitted version.

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Media Representations of Official Declarations and Political Actions in Brazil During the COVID-19 Pandemic

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Our case study situates science communication within the interaction of the COVID-19 disease, scientific research about the disease, public statements by relevant officials, media messages, political actions, and public opinion. By studying these interactions in the Brazilian context, we add to the understanding of science communication complexity by studying a context less easily available to the English-speaking research community. Methodologically, we identified key moments in Brazil during the pandemic using tools such as Google Trends, and content analysis of influencers' Twitter and Instagram accounts and digital newspapers. These episodes are then explored as case studies, using both quantitative and qualitative content analysis of messages to identify message emphasis frames and political agendas. The results introduce issues rarely explored in previous science communication research, especially ones associated with nationalism and political populism and national inequalities of privilege, income, and trust.

Keywords: media representations, political action, Brazil, COVID-19, pandemic, emphasis frames

INTRODUCTION

Different countries have responded to the SARS-CoV-2 virus and COVID-19 pandemic in diverse ways. Many factors have affected how people have responded to the crisis, such as traditional and cultural habits, their level of trust in science, the statements of political leaders, influencers and media, and official health institution guidance. In order to understand these factors, we must first have a clear picture of who was presenting information, what information they were presenting, and how that information correlated with events and expressions of public opinion. This article seeks to establish those baselines for the case of Brazil.

Understanding the landscape of pandemic information is particularly important for understanding public communication of science because of the rapid changes in how information becomes available to public audiences—through news organizations, through pre-print and open-access publishing platforms, through direct education sites (such as TED talks), and especially through social media both as a tool for spreading all the other sources and as sites for discussion of those sources. Science communication is based on the idea that experts have knowledge to which publics need access in order to combine it with other information and with personal and national values in a process of making meaning (Gilbert and Stocklmayer, 2013). Yet various aspects of the pandemic have complicated the process of assessing what information comes from experts and the degree to which it should be trusted—aspects such as direct access to pre-prints,

reduced time for experts to respond to public concerns (de Oliveira and de Oliveira, 2020), changing statements from trusted organizations such as the World Health Organization (WHO) and the US Centers for Disease Control (CDC), and in some countries the politicization of information about the pandemic.

Brazil has been one of the countries most damaged by the COVID-19 pandemic. During the pandemic, many Brazilians failed to take protective measures, despite scientific and public health consensus. Anecdotaly, these failures appeared to be responses to several statements made by WHO officials and by the Brazilian president, Jair Bolsonaro. There were also demonstrations of disrespect by members of the financial and educational elite toward scientific and public health officers, health controllers, and peaceful protestors seeking greater public response.

This context allows us to explore a context too little studied in science communication research: a major industrialized country outside of North America and Europe. For this analysis, we have chosen to use the concept of “emphasis framing” (Scheufele and Iyengar, 2015). Importantly, we have taken note of recent critiques attempting to clarify the theoretical meaning and use of framing (Cacciatore et al., 2016). We are not claiming that emphasis frames lead directly to public responses (media effects). We are focused on describing those frames as they were produced by multiple sources, following D’Angelo and Kuypers (2010, p. 5) who “regard frames as embedded in a web of culture, an image that naturally draws attention to the surrounding cultural context and the threads that connect them.”

Our definition of emphasis frames addresses the wide range of sources that produce information about the virus and the pandemic, ranging from individual scientists, to research institutes, to science-based national and international government agencies (such as WHO and local public health organizations), to political, economic, and social leaders. We follow Reese (2001, p. 11), defining emphasis frames as “organizing principles that are socially shared and persistent over time, that work symbolically to meaningfully structure the social world.” This definition suggests that emphasis frames manifest themselves in a number of different sites and across a number of domains, including policy, journalism, and public expression (D’Angelo and Kuypers, 2010).

For this study, we begin with a qualitative identification of events in Brazil that have impacted the society because of their political and cultural appeal during the COVID-19 pandemic. In examining this series of episodes in Brazil, we expect to see particularly the interweaving of emphasis frames and political agendas. We hypothesize that various elements of national culture (such as patriarchal expectations) and political ideology (such as populism) will appear frequently in both official and media messages. We will be especially observant of messages linked with misinformation, political oppression, and science denial.

Because our analysis seeks to link emphasis frames with aspects of Brazilian culture, we need to introduce key aspects of Brazilian history that have been identified by historians, anthropologists, sociologists, and other social scientists. Invaded (not discovered) in 1500 C.E. Brazil carries in its roots

the structure of a Portuguese colonial and agrarian society based on economical exploitation and slavery—first subjugating indigenous people and later afrodescendents—when “the masters (...) in exercise of a political or administrative elevated position had the simple and pure violent and perverse taste of command” (Freyre, 1980, p. 54). After the abolishment of slavery was declared—but not strictly implemented—the focus of the economy switched from rural areas to urban ones. And with this change, the Big House mentality entered the cities¹. “Stereotyped by long years of rural life, the mentality of the big house thus invaded the cities and conquered all professions, without excluding the most humble” (Holanda, 1969, p. 55, 56).

Today, “the rigid social hierarchy and the monopoly of information, in the hands of a few, explain[s] the arrogance and authoritarianism of the ruling class” (de Sousa et al., 2020, p. 23). This elite perspective dominates public discourse, even as people beyond the elites gain political power. As Freire (2014, p. 44) indicates, when there is not liberating education, the oppressed want to become in turn oppressors.

A few other key issues in thinking about Brazil: Inequality is extreme—in 2019, the poorest 10% had <1% of the monthly household income per capita, while the richest 10% had 43% of the household income. The income of the population’s richest 1% was more than 33 times greater than that of the poorest half (IBGE—Agência de Notícias, 2019)². The situation has gotten worse in recent years: According to a recent study, Brazil in 2019 dropped five positions in the Human Development Index ranking³. These economic issues have a direct effect on the course of the pandemic in Brazil: “The poorest 20% of the population had twice the risk [of infection] than the richest 20%—even though the pandemic arrived in Brazil through airports, by people of higher socioeconomic status” (Hallal et al., 2020). As mentioned, Brazil in 1888 was the last country in the western world to abolish slavery—in theory—but in practice it still exists: From 1995 to 2020, according to the Ministry of Labor of Brazil (2020), 55,004 workers were released from contemporary slave labor in the country. Thus, the social structure of elites controlling parts of the population is part of the culture. This also connects to issues of violence: Although overall violence in Brazil is about average for countries worldwide, homicides in particular are very high, reinforcing images as a violent crime-ridden country (Muggah and Aguirre Tobón, 2018; Cerqueira and Bueno, 2020). In 2019, women held only 15% of parliamentary positions (Women in Parliaments: World Classification, 2019). Among the 50 most important national media outlets in Brazil (TV, radio, print, and Internet), 31 belong to just eight groups. “The media system indicates high concentration of audience and ownership, high geographic concentration, lack of transparency, besides religious, political and economical interference” (Reporters Without Borders, 2020).

¹The casa-grande (“big house”) refers to the slave owner’s residence on a sugarcane plantation, where whole towns were owned and managed by one man. The senzala (“slave quarters”) refers to the dwellings of the black working class, where they originally worked as slaves, and later as servants (Wikipedia Contributors 2020).

²Agência de Notícias (2019).

³United Nations Development Program (2020).

Many factors have contributed to one of the most chaotic national responses to the new coronavirus. As of December 2020, Brazil occupied the third position in absolute confirmed cases, second in number of deaths, and ninth in deaths per 100,000 population⁴. We do not claim that specific media emphasis frames led to this chaos. But we suspect that patterns in those frames help us understand the ways the Brazilian population responded to political leaders' statements, to protests intended to raise awareness of social distancing or the use of masks, and to how official statements have been misinterpreted to favor science denial "arguments." To assess these issues, we pose the following questions:

- 1) How did traditional and social media address the importance of following health measures toward COVID-19?
- 2) What kinds of different emphasis frames appear in main media outlets, especially from key or influential actors during the pandemic?

MATERIALS AND METHODS

Our study draws primarily on qualitative methods, though we also use quantitative data as one dimension of our understanding of the context. First, we identified from our own experience as dedicated (even obsessive!) media-watchers more than 20 events during the period March–August 2020 (in practical terms, the first 6 months of the pandemic's presence in Brazil) that stood out as important moments in the Brazilian context (see **Supplementary Material** for full list). We then collected the number of news stories about those events appearing in the three main traditional newspapers in Brazil—*Folha de São Paulo*, *O Globo*, and *O Estado de São Paulo*—using the official database from each newspaper. Acting on the methodological principle that controversies reveal strains in social processes that are usually hidden (Bartlett, 2019), we identified six events (**Table 1**) that both stood out as being above the median number of overall articles (**Figure 1**) and also where the media stories went beyond simply reporting of events—the six events had some element of controversy or disagreement that was part of the public discussion. We focused our more detailed case studies on those six events, which we classified in three categories: statements by political leaders or institutions; major protests; and attacks on public health and civil agents.

For each of the six events, we collected: number of keyword searches on Google related to each event (using Google Trends); posts on Twitter and Instagram from media influencers addressing the events; and also the news stories we had already collected from the three main traditional newspapers in Brazil. To identify influencers or key people, we used a report ordered by the Brazilian Government from a communication company in which 81 professors, influencers and journalists were ranked as "detractors," "neutral," or "favorable" [to the Government]⁵. We complemented the list with another 75 profiles identified by the Ideological GPS based on a methodology proposed by

Barberá et al. (2015)⁶. We downloaded the social media content on Twitter and Instagram from these influencers, creating a textual database with 580,629 posts. From this database, we identified 361 items related to the six key events, using the same event keywords to identify the influencers' content. The items generated 2,045,740 "likes," with similar patterns of engagement on Twitter and Instagram.

Overall our goal was to understand the ways that traditional and social media were used to discuss the pandemic and potential vaccines. Thus, we read qualitatively to identify the main topics—politics, science, national focus, worldwide pandemic, danger, hope, and so on. We also identified more specific frames such as national culture (patriarchal expressions), and political ideology (populism). We did not use formal coding or grounded theory to identify the topics and frames.

RESULTS

Political Leader Provides Guidance and Disinformation Based on World Health Organization Statement

Jair Bolsonaro's Second Speech During the Pandemic: A Sequence of Wrong Interpretations of Science

After the World Health Organization (WHO) declared the new coronavirus pandemic, on 11 March 2020, political leaders had the opportunity to raise awareness and limit risk, spread and impact. The first substantial media linkage of Brazilian President Bolsonaro with the pandemic occurred the next day (**Figure 2**), when he acknowledged the WHO as acting "in a responsible manner" (the Google Trends data in **Figure 2** and in subsequent figures documents that the general keywords shown in **Table 1** coalesce around the particular event). In the same speech, he announced that the government was handling the situation, cited the Public Brazilian Health System (SUS) and its capacity to meet the demands, and encouraged people to avoid crowds—including mass gathering organized to support him scheduled for 15 March 2020. That seemed a reasonable response to a serious situation.

However, 12 days later, on 24 March 2020 Bolsonaro addressed the nation for the second time and changed his tone dramatically⁷. This time, the social media postings based on his speech (from him and others) framed the pandemic as a media exaggeration and as creating a false dichotomy between choosing the economy or choosing restrictions⁸. Beyond his declarations on the political measures of his government, he blamed the press for "spreading fear by announcing the large number of victims in Italy, a country with a huge number of ancient people and with a totally different weather." Bolsonaro also argued against social distancing that experts argued was needed to

⁴Folha de S.Paulo (2020a).

⁵Planalto (2020).

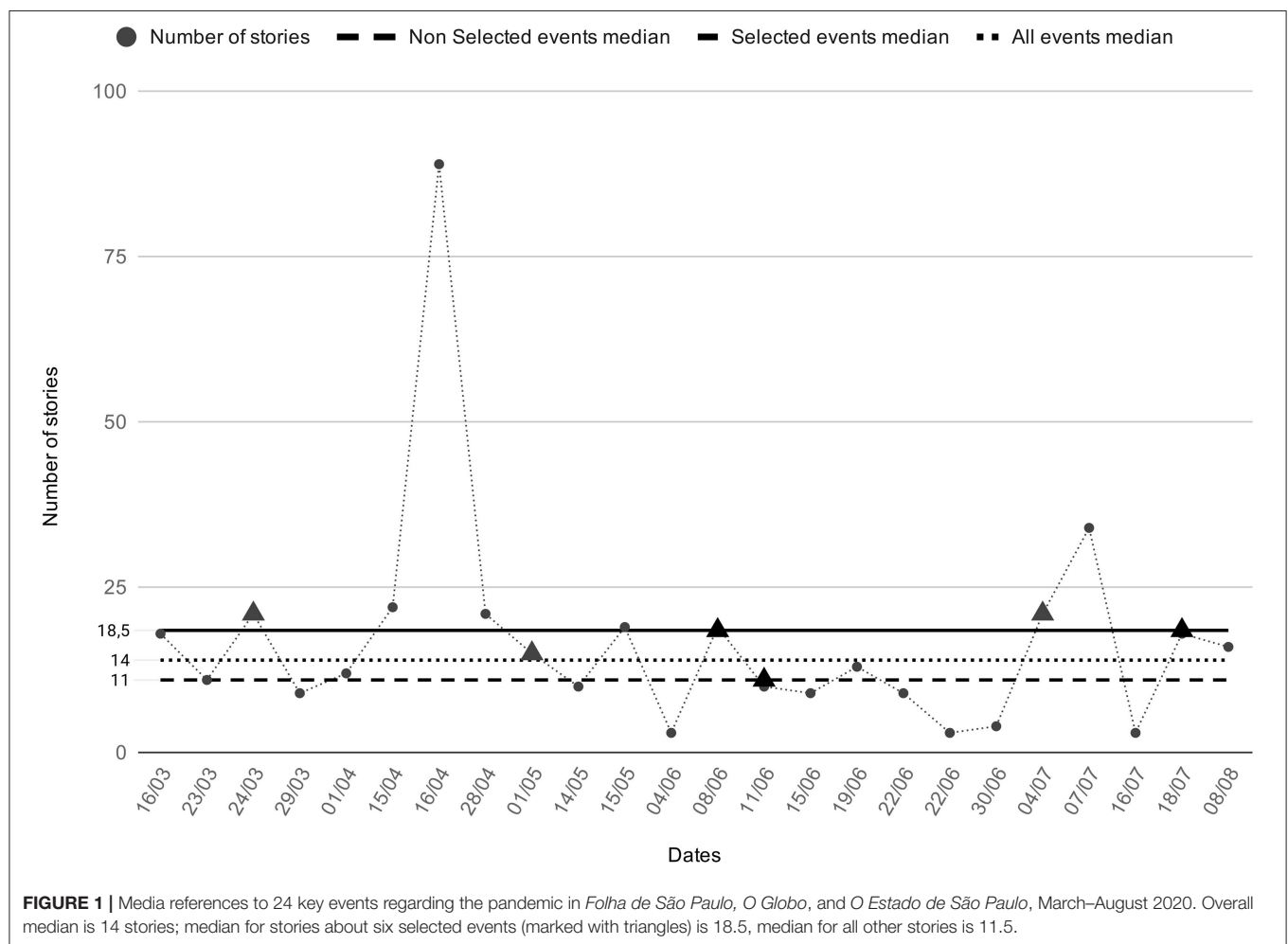
⁶Six days after Bolsonaro's speech, Cássia Almeida from *O Globo* published a news story "Estudo Mostra Que Isolamento Social Leva à Recuperação Econômica Mais Rápido." *O Globo*. March 30, 2020. <https://oglobo.globo.com/economia/estudo-mostra-que-isolamento-social-leva-recuperacao-economica-mais-rapido-24338226> based on Correia et al. (2020).

⁴Johns Hopkins Coronavirus Resource Center (2020).

⁵UOL (2020a).

TABLE 1 | Timeline of events selected for analysis.

Event	Date	Keywords	Category
Bolsonaro addresses the nation	24 March	Pronunciamento, discurso, Bolsonaro, cloroquina [pronouncement, speech, Bolsonaro, chloroquine]	Official Statements
Protest on social distancing	1 May	Protesto, enfermeiros, Praça dos 3 Poderes, militantes, distanciamento social [protest, nurses, Three Power Square, activists, social distancing]	Protest
WHO statement on asymptomatics	8 June	OMS, assintomáticos, transmissão, COVID [WHO (World Health Organization), asymptomatic, transmission, COVID]	Official Statements
Protest on the federal government measures	11 June	Protesto, cruzeiros, ONG, pai, vítima [protest, crosses, NGO, father, victim]	Protest
Couple disrespects health agents	4 July	Cidadão, engenheiro civil, bares, Leblon, aglomeração [citizen, civil engineer, bars, Leblon (a wealthy neighborhood in Rio), crowd]	Disrespect
Appellate judge refuses to wear a mask	18 July	Desembargador, máscara, multa [appellate judge, face mask, fee]	Disrespect

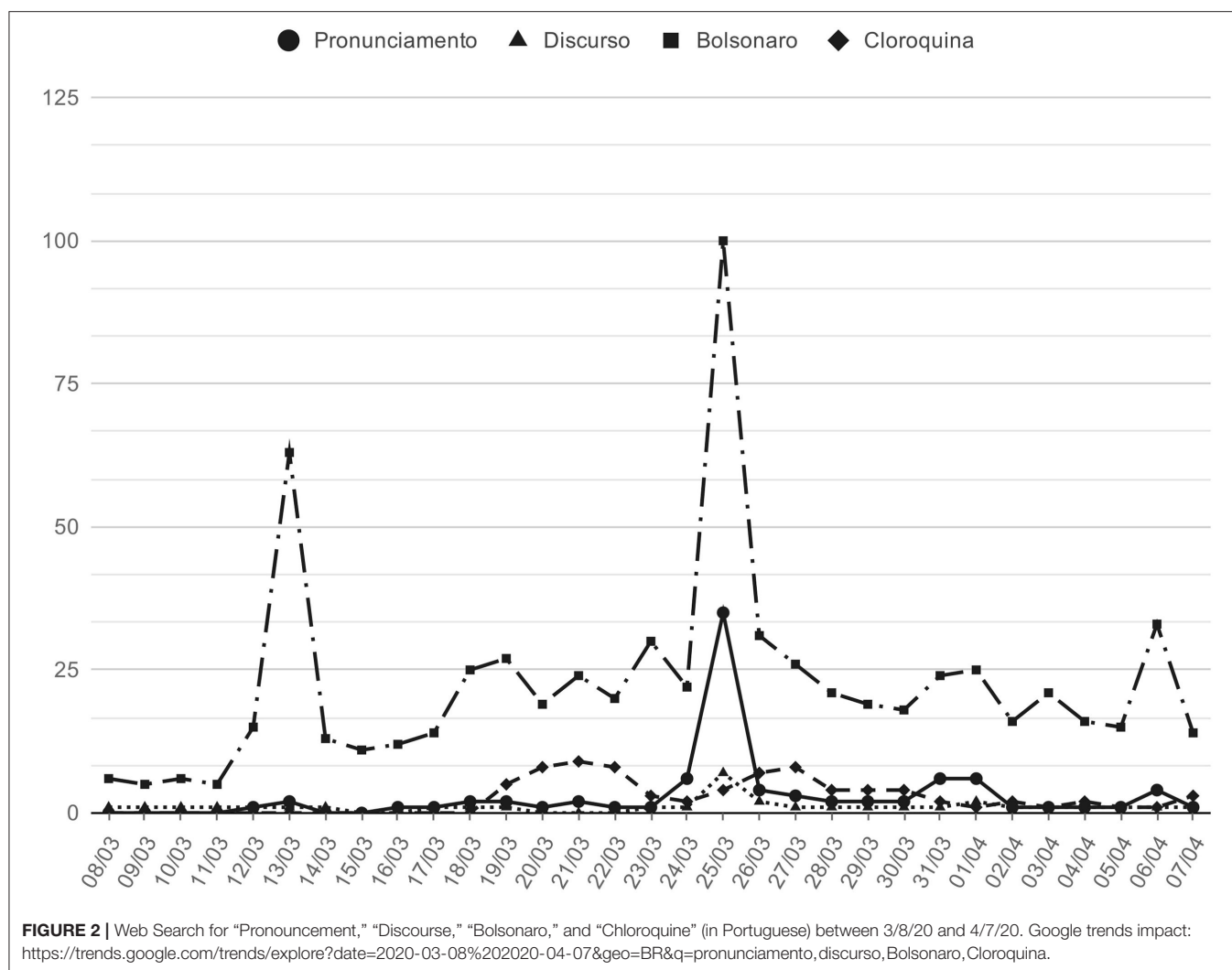


preserve the economy. “Life must go on and employment must be maintained. Livelihood must be preserved. Yes, we must get back to normality.” As a possible treatment for the new coronavirus disease, Bolsonaro introduced to the public debate in Brazil the drug chloroquine.

Bolsonaro’s second speech was strongly criticized in the three main newspapers. *O Estado de São Paulo* produced at least 10 stories criticizing misinformation in the speech and

highlighting political dimensions: the *panelaços* [protests using the noise of pots and pans⁹] in the largest cities, criticism from influential politicians—both opponents *and* supporters—of the misinformation, and the insensitivity of his frame of economy vs.

⁹Similar to cacerole is a form of popular protest which consists of a group of people making noise by banging pots, pans, and other utensils in order to call for attention. In Brazil it’s made not in the streets but from inside apartments and houses.



lockdown: “Unfortunately some deaths will happen. Patience, it happens, and let’s move on.”

Bolsonaro’s speech was widely reported on social media. We found 120 tweets or Instagram posts from 43 different influencers. But the 10 most liked tweets and posts on Instagram came largely from Bolsonaro and his supporters. Bolsonaro’s own post announcing his speech was liked more than half a million times on Instagram and his son’s post on Twitter added another 150,000 likes.

Other influencers did question Bolsonaro’s statements, introducing frames of incompetence and even criminality. A comedian and former supporter said that Bolsonaro didn’t deserve the chair of the President because he was concerned with his self-image and not with people. A liberal journalist called Bolsonaro’s statement “criminal” and his acts a “genocide.” A left-wing politician said that Bolsonaro “debauched” people and called his statements “irresponsible.” Another journalist—considered “neutral” by the Government itself—described a *panelaço* protest in the wealthy neighborhood of Higienópolis, in São Paulo.

The frame arguing that a lockdown would not protect economic activity appeared quickly: Allan dos Santos, a conservative blogger, wrote: “Exactly: #BrazilcantstopBrazil”¹⁰. This hashtag was also shared by Bolsonaro’s sons and five other profiles from our sample. Posts in this frame argued that social distancing or lockdown would provoke a decrease in economic activities that would be worse than the virus spread itself. These posts also argued against the framing of Bolsonaro’s actions as a “genocide.” Camila Abdo, another conservative blogger identified in the government report as “favorable” to them, said “The president is trying to save the economy. It is unacceptable to be called a genocide when the income of slum dwellers has fallen by 70%. This is fair? Genocide advocates that people die of hunger.” None of the posts from supporters of Bolsonaro contained scientific evidence.

On the other hand, posts criticizing Bolsonaro’s speech often used science-based arguments. Debora Diniz, a well-known anthropologist and law professor at the University of Brasília,

¹⁰Twitter (2020a).

said: “If I were Bolsonaro’s health minister, today I would make a statement, in which I would read the president’s speech, correcting it with each line. It would show the health impact of errors”¹¹.

Another influencer, Átila Iamarino, a biologist who defines himself on his Twitter account¹² as a “science communicator and world explainer by choice,” responded to a question about what to recommend with a frame of competence: “Constant pronouncement from everyone at the federal level recommending that people distance themselves and wear a mask. Recommending that they avoid contracting the virus, instead of thinking that it can be treated early. The mantra has a reason.”

The WHO Statement on Asymptomatic Transmission

Two months later, on 8 June 2020, WHO official Maria Van Kerkhove triggered confusion¹³ and questions among outside experts and health officials when she said that: “From the data we have it still seems to be rare that an asymptomatic actually transmits onward to a secondary individual.” The next day, she made a “clarification” that “some estimates” had found between 6 and 40% of the population of transmission may be due to asymptomatic transmission. This confusion led to Bolsonaro and his supporters circulating misinformation (Figure 3).

For this event, we found 82 tweets or Instagram posts from 35 different influencers. The top 10 most liked posts and tweets almost all supported Bolsonaro’s narrative that simultaneously accepted a misinterpreted version of WHO’s information while questioning the competence of WHO. Bolsonaro’s own tweet on the subject had almost 85,000 likes. Bolsonaro claimed to be right about the use of hydroxychloroquine as a treatment for COVID-19 and stated that the WHO “concludes that asymptomatic patients (the vast majority) have no potential to infect others.” He once more framed the debate as being about a choice between the economy and restrictions. He was supported by eight out of the next nine top posts in our sample from Instagram and Twitter, often with a frame questioning the competence of WHO. Carla Zambelli, a conservative congresswoman, posted a meme in which Bolsonaro appears as the person who was trying to keep people from being deceived¹⁴. “He warned!” she wrote. Another conservative congresswoman, Bia Kicis, showed a 10-minute clock in which each minute contradicts the previous one regarding: the severity of coronavirus, the use of masks, the use of hydroxychloroquine, lockdowns, and the transmission by asymptomatics. The only voice that tried to interpret Van

Kerkhove’s words came from Átila Iamarino. He said the studies were not confirmed and the statement was “missing a lot, like the difference between asymptomatic and pre-symptomatic.” Iamarino posted a long thread on Twitter trying to explain his points, but it never had the same number of likes and sharings and nor the power to make people assimilate its content as the meme oversimplifications.

Iamarino’s long Twitter thread demonstrated the difficulty of addressing oversimplifications on social media. But the three main traditional newspapers in Brazil did try to explain the misunderstanding generated by the WHO. *Folha de São Paulo* developed the first fact checking agency in Brazil: Lupa (“magnifier glass”). The journalist Jaqueline Sordi wrote a detailed timeline about the studies available at the time and added: “Van Kerkhove explained that her speeches were based on personal interpretations of the latest update to the WHO Guide to Wearing Masks, published on June 5”¹⁵. *O Globo* published a story with a list of researchers and scientists who criticized Van Kerkhove’s declarations. *O Estado de São Paulo* went beyond and reported other situations where WHO staff declarations were taken out of context¹⁶.

All three main Brazilian newspapers addressed the frames that Bolsonaros was using: the question of WHO competence, and the false dichotomy between economic activity and pandemic restrictions. *Folha de São Paulo*, *O Estado de São Paulo* and *O Globo* published 19 stories during the 7 days immediately following Van Kerkhove’s declarations. They reported that the Brazilian president threatened to remove Brazil from WHO because “it lacks reliability” and “looks like a political party” (the “WHO competence” frame). At the same time, throughout the week after Van Kerkhove’s statements, they reported on Bolsonaro’s declarations that the head of the emergency program would shorten containment policies in Brazil, such as isolation and lockdown; on this issue, the coverage highlighted the “economy vs. lockdown” frame. The articles quoted Bolsonaro: “Who knows? After that declaration [from WHO about asymptomatics], we may be able to return to the normality that we had earlier this year,” he said. “This information will certainly change the orientation of governors and mayors about isolation and confinement.”

Protests to Raise Awareness About Different Aspects of the Pandemic

A Protest for Better Work Conditions and Promoting Social Isolation

Around the globe, health workers on the front lines of the pandemic took risks and struggled with bad conditions and lack of equipment¹⁷. In Brazil, on 1 May 2020, a group of 60 nurses held a silent and peaceful protest to raise awareness

¹¹Twitter (2020b).

¹²Twitter (2020c).

¹³World Health Organization (WHO) (2020a).

¹⁴The post by representative Carla Zambelli shows two headlines:

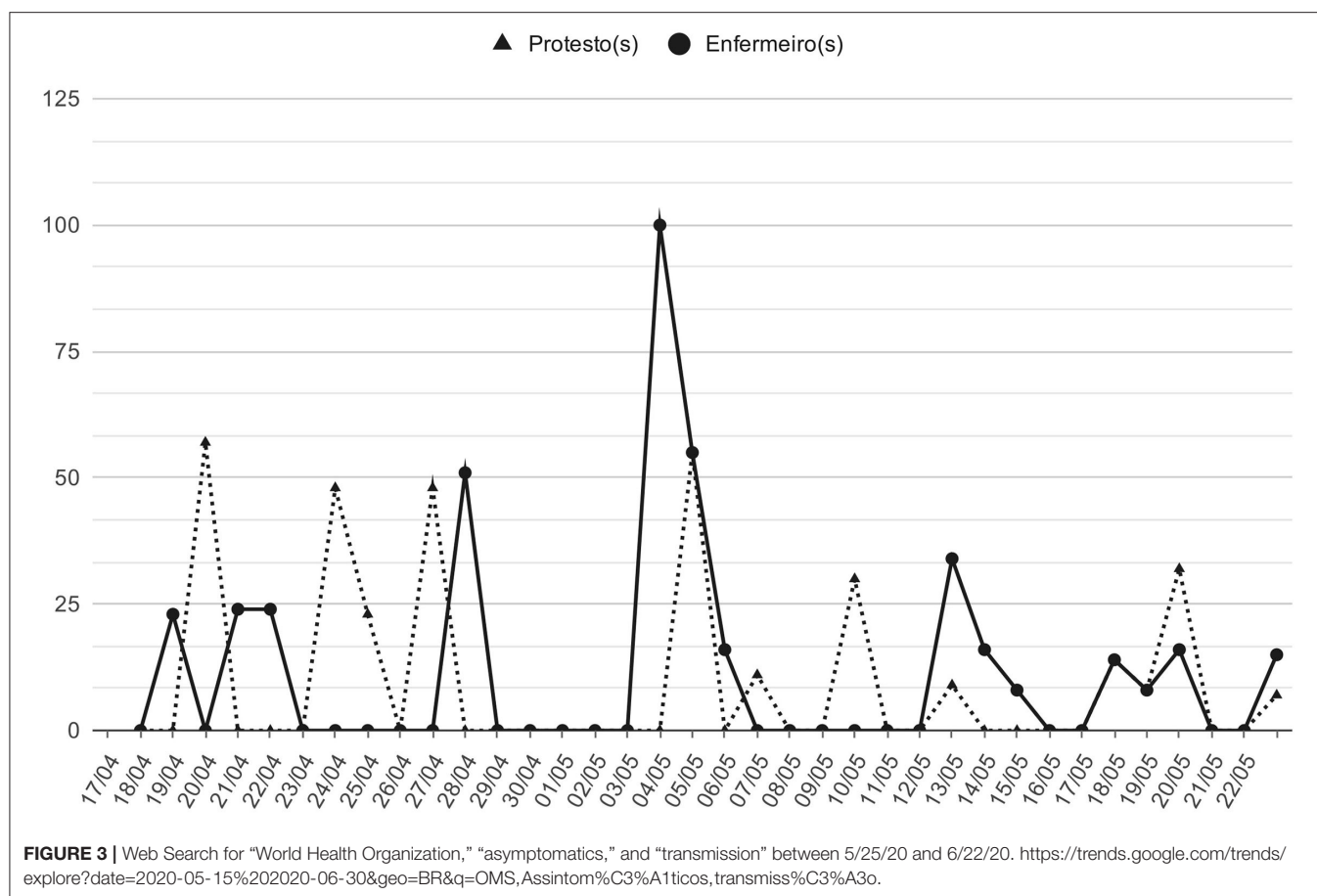
- (1) Bolsonaro: people will discover that they were deceived about COVID-19. President again affirmed that there is an exaggeration in the measures to fight coronavirus
- (2) Transmission of COVID-19 by patients without symptoms appears to be rare, says WHO. The head of the World Health Organization (WHO) emergency program, Maria van Kerkhove said that transmission of COVID-19 by patients without symptoms appears to be “rare”

She ends her post by writing:
HE WARNED!

¹⁵Sordi (2020).

¹⁶For example, such as occurred to Michael Ryan, the epidemiologist specialising in infectious disease and public health Director of the WHO Health Emergencies Programme. His phrase “economies have to open up, people have to work, trade has to resume” said on July 27th “does not represent a change in WHO’s discourse nor an immediate guidance for the suspension of quarantine measures as misleading posts on social media make believe” (Estadão, 2020a).

¹⁷Estadão (2020b).



of the dire situations at hospitals and to warn people about the importance of social distancing for decreasing the number of hospitalizations and deaths. Peaceful protests are a resource (Lipsky, 1968) and “linked to themes that are inscribed in the culture or invented on the spot or—more commonly—can blend elements of convention with new frames of meaning” (Tarrow, 2011, p. 29). At Praça dos Três Poderes in the capital city of Brasília—a square surrounded by the Brazilian Parliament, the Executive Leader Palace and the Supreme Court—the group, dressed in lab coats and wearing protective masks, stood in rows, holding crosses and respecting the recommended distance of at least 6 feet between each person. The nurses held posters with phrases such as “Nursing in mourning for professionals who are victims of the COVID-19” or “Stay at home.” The act also paid homage to the memory of the 55 nurses, technicians, and assistants who had already lost their lives on the front lines due to coronavirus.

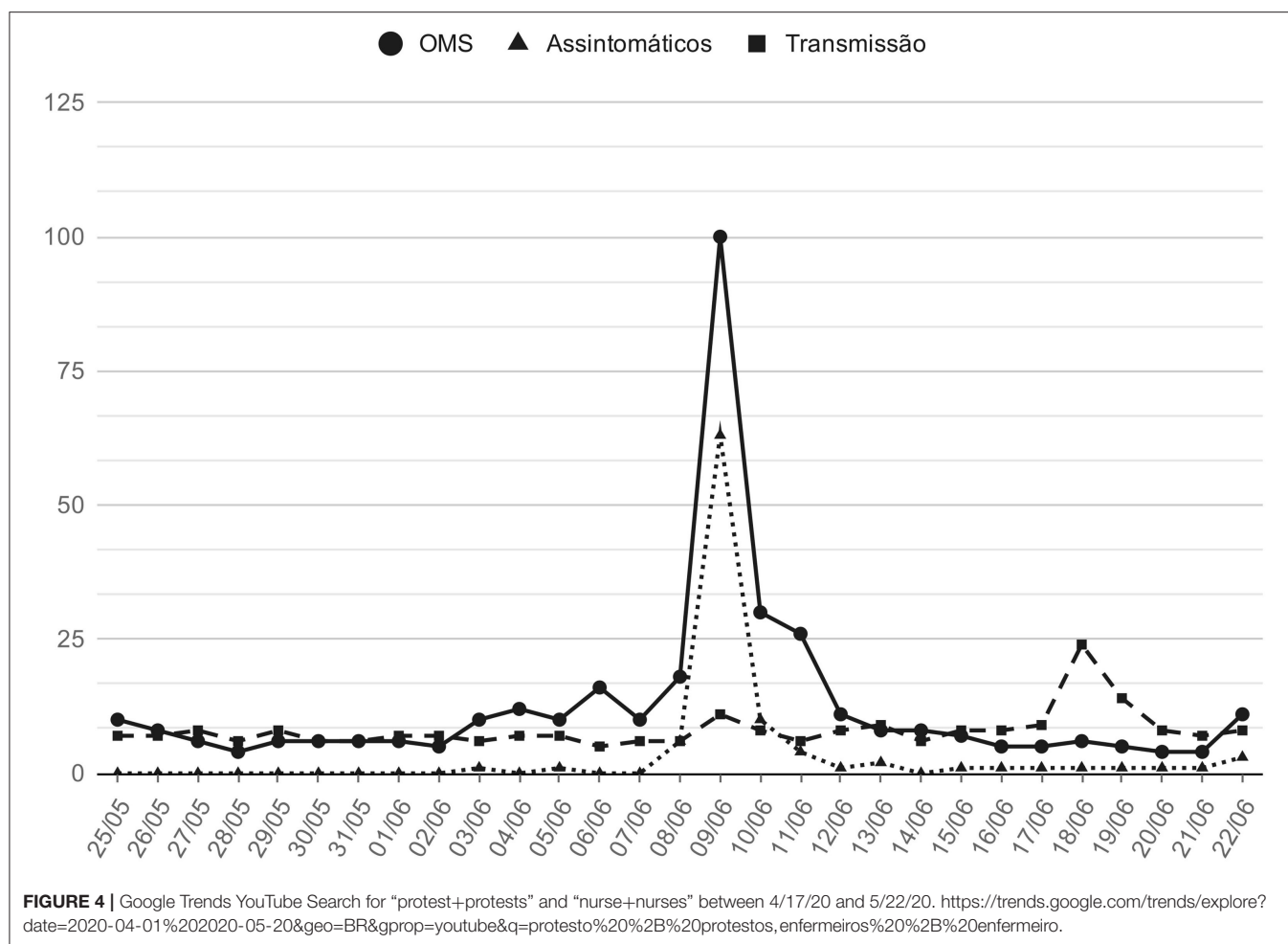
During the peaceful protest, a group of Bolsonaro supporters arrived and yelled angrily at the protesters, calling them “shameless,” “cowards,” and “functional illiterates.” “We smell your person and we know that you don’t shower properly,” yelled a woman against one of the women protesters. One of the attackers made a video and posted on social media, saying that the protest was “fake news,” that homeless people had been approached and convinced to wear white coats to pass for

doctors. After exceeding 20,000 views, the video was deleted, according to the Regional Nursing Council of the Federal District (Coren-DF). The provocateurs were identified by the Coren-DF and sued. “The episode portrays the sad reality of thousands of nursing professionals, who work to save lives and suffer violence in hospitals in the country, silently, silently, with no chance to defend themselves,” stated Coren-DF.

To document Internet-based interest, for this event we found that assessing YouTube searches on Google Trends worked best. We suspect that people wanted to see the images of the protest rather than reading news stories. As **Figure 4** shows, searches on Google Trends (YouTube) for “nurses” and “protests” surged 2 days after the protest took place. The search for “nurses” became constant during the pandemic, when compared to previous years.

We identified 48 tweets and Instagram posts from 22 individual influencers. Among the top 10 posts, the majority came from individuals identified with left wing politics. Two of the individual influencers (Jean Wyllys and Debora Diniz) had experienced extreme hostility, having to leave the country because of frequent threats from the far right¹⁸. All of the

¹⁸Jean Wyllys is a journalist, a lecturer, and Brazil’s second openly gay member of parliament and the first congressman who was a gay-rights activist. Debora Diniz is a law professor at Universidade de Brasília.



top 10 posts on this issue—even one from a far right-wing representative, Joice Hasselmann, who was until 2020 a Bolsonaro supporter—used a frame showing that intolerance disguised as love for homeland allowed political radicalism to overcome humanity or compassion. A related frame highlighted the lack of empathy toward professionals who should be acknowledged as heroes.

The particular issue of peaceful vs. violent protests is also interesting, because of the way different sides framed what constituted “violence.” Protests that turn violent are frequently denounced by Bolsonaro’s supporters as an illegitimate form of raising awareness. In both this specific event and the next one, the protests were peaceful until attacked by the president’s defenders. The traditional media described the violence as coming from Bolsonaro’s supporters: “The silent protest ended after supporters of President Jair Bolsonaro verbally assaulted the professionals,” said *O Globo*. “Nurses are attacked by Bolsonarists during a silent act for social isolation,” published *Estadão*. On the other hand, Bolsonaro offered a different frame: “I ordered to investigate if there was a criminal offense (by the nurses), he [the real aggressor] didn’t ask for that. So, if there was aggression, it was

verbal, which they do to us all the time. There was zero aggression”¹⁹.

Protest Against the Brazilian Government Actions Toward the Pandemic

Another peaceful protest became violent 5 weeks later, this time in Rio de Janeiro²⁰. On 11 June 2020 the non-governmental organization Rio de Paz (Rio of Peace) dug graves and stuck 100 crosses at Copacabana Beach, symbolizing the overwhelmed cemeteries and 38,406 deaths from COVID-19 until that day in Brazil²¹. The NGO was asking for assistance for families in vulnerable situations, for a medical professional to be in charge of the Ministry of Health²², and for a clear plan with explicit goals for combating the disease to be issued by federal,

¹⁹ *Estadão* (2020c).

²⁰ G1 (2020c).

²¹ World Health Organization (WHO) (2020b).

²² Luiz Henrique Mandetta, Bolsonaro’s first Minister of Health (1 January 2019–16 April 2020) was succeeded by Nelson Teich (17 April–15 May 2020). Both are medical professionals and were fired due to disagreements on the use of chloroquine as a treatment to COVID-19. General Eduardo Pazuello—an expert in logistics—became acting Minister on 2 June and assumed office on 16 September

state and municipal governments. But then a 78-year-old man, Héquel da Cunha Osório, knocked down the crosses. Media stories highlighted his framing of the issue as being about public spaces: “I’m going to take this one out. If they have the right to put it... The beach is public. I have the right to take it out. This is an attack on people. This is a terror. It’s creating panic. Using the crosses... The cross of Jesus to terrorize the people,” he said. The next day, in a WhatsApp group, da Cunha Osório explicitly tied his act to partisan politics: “Has anyone seen my indignation, dropping crosses that the lefties mounted in Copacabana today? I couldn’t resist”²³. One of the 10 most liked tweets was from Hildgard Angel, a journalist ranked as a “detractor” by the Brazilian Government. In her post she shared a news story press showing that Héquel’s son, Hequel Pampuri Osório, was condemned for the misuse of privileged information, the so-called insider trading, which is a crime in Brazil, adding to a frame about the special privileges given to elites.

An alternative frame of respect for victims was also available: Immediately after da Cunha Osório knocked down the crosses, Marcio Antonio, the father of a coronavirus victim, replaced them. Antonio had lost his 25-year-old son on 18 April 2020 and was surprised—according to him in a positive way—to see the demonstration while walking on the boardwalk.

“I was not protesting at all, so it was just a father’s emotion. I was so happy, because I said: hey, a tribute, a tribute for the victims. I felt that nostalgia a little in my heart. When someone arrives and kicks a representation of a person, a victim... This is not freedom of expression. This is just anger, hate, I don’t even know the name for it.”

Although this second protest did not lead to a noticeable spike on Google Trends (Figure 5), social media posts explicitly linked the event with the protest that took place in Brasília 45 days earlier. Overall, 26 tweets or Instagram posts were created from 13 different influencers. Tweets and posts on Instagram compared the events—both were initially peaceful, both were attacked by the president’s defenders, and both were trying to raise awareness of the importance of taking health measures. Nine out of 10 Instagram posts or tweets highlighted the empathy frame, pointing out that the statements by Bolsonaro’s supporters showed “contempt” or “disrespect” for life and suffering. “The same contempt of Jair Bolsonaro for the dead and the pain of their families. It’s too inhuman. Followers of the president attacked a demonstration by [NGO] Rio de Paz on Copacabana beach and took out the crucifixes placed in honor of the Brazilians who lost their lives,” said Marcelo Freixo. Debora Diniz called attention to the phrase used by the father in Copacabana: “Respect people’s pain!” She said:

“Respect the pain of mourning for the 41,058 people who died of covid in the country. • The @riodepaz act was peaceful. Crosses in pits on Copacabana beach. The gesture called for silence.

2020. In October, O Globo reported that the Ministry of Health had distributed <10% of the hydroxychloroquine received as a donation. Mariz (2020).

²³O Globo (2020a).

To symbolize a country that burns with longing for lost love, there was a flag on the crosses. • The flag became a bolsonarista property. A free pass for the hatred of people who operate by the spectacle of shouting, force and intimidation. A Bolsonarist avenger stood to take down the crosses, as if he were operating for the squad that hides the numbers of the dead. • The father raised each cross with the anger of those who suffer. With each cross of the cross in the sand, a cry. The cry of insomniacs for the mourning of a tragedy. • Leave the crosses. Let the father scream. He mourns the longing for his 25-year-old son driven by the pandemic”²⁴.

Joice Hasselmann—who right after being elected congresswoman in 2018 with the largest margin of votes in history said “I want to be Bolsonaro in skirts”²⁵—had two posts on Instagram among the top 10 about this event. The hashtags framing her posts included #grief #respect #solidarity #pain #losses #family #sensitivity #solidarity and #empathy. The only tweet to ridicule the protest was made by former rock band leader and conservative Roger Moreira. He brought into the debate a recurrent frame used by Bolsonaro’s supporters: if someone is not at their side, this person is an enemy of the homeland. In this case, the content of the post labeled the opponent as a communist, but the perspective was the same.

In traditional media, *O Globo* quoted Antonio Carlos Costa, the president of Rio de Paz, the NGO that organized the protest installation. His comments addressed the violence frame “We were hearing many expressions of hate on the boardwalk, people teasing us. But even when a man decided to knock over the crosses, we didn’t react”²⁶. *Folha de São Paulo*’s use of the violence frame also contrasted the protestors with the attackers: “According to Lucas Louback, project coordinator and activist at Rio de Paz, none of the organization’s volunteers tried to stop the man who knocked over the crosses”²⁷. “Our act was intended to signal a representation of the chaos that has become the health care system and we represent that through the ditches. Some interpreted it as an act of a political character and started to attack us.”

Attacks on Public Health and Civic Officials Officials From the Brazilian Sanitary Agency Attacked After Dispersing Crowds in Bars in Rio

On 4 July 2020, inspectors for the Brazilian Sanitary agency tried to disperse crowds gathering in bars in the wealthy districts of Leblon and Barra da Tijuca in Rio—it was the first opening after 3 months of lockdowns²⁸. One couple who weren’t wearing masks, Leonardo de Barros and Nivea Valle, tried to intimidate the agents. The following dialogue took place:

Leonardo: You’re not going to talk to your boss, are you?

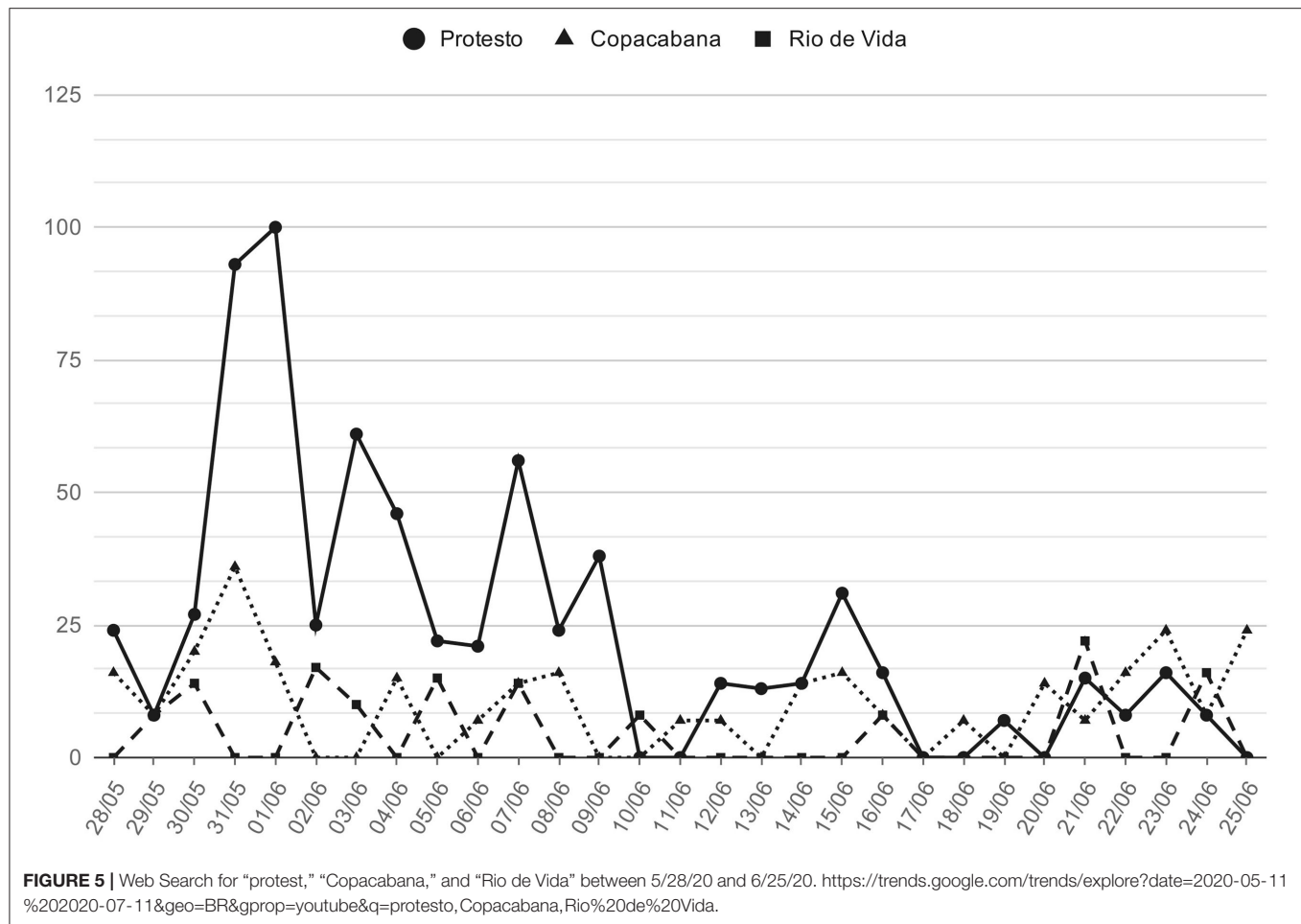
²⁴“Debora Diniz on Instagram: “Respeitem a Dor Das Pessoas”. Ele Falava Da Prpria Dor. Respeitem a Dor Do Luto Pelas 41.058 Pessoas Que Morreram de Covid No Pas. •...” 2018. Instagram.com. 2020. https://www.instagram.com/p/CBVMR4TL_Pp/.

²⁵Balloussier (2018).

²⁶O Globo (2020b).

²⁷Folha de S.Paulo (2020b).

²⁸G1 (2020a).



Nivea: We pay you, son. Your salary comes out of my pocket.
 Leonardo: Where's your tape measure? I want to know how you measured without a tape measure.
 Agent Flávio Graça: Okay, Citizen.
 Nivea: Not a citizen. Civil engineer, trained. Better than you.

The confrontation was captured by a Globo TV program called “Fantástico” and broadcast that night. The health agent, Flavio Graça, is a professional in the Secretariat for Sanitary Surveillance and Zoonosis Control (SUBVISA), a veterinarian with multiple degrees and a researcher in the area of animal health. Due to a national outcry about the lack of respect for an official, Valle was fired the next day from a private company. Her dismissal was celebrated on social media as the term #unemployed went to trending topics on Twitter. de Barros was fired 3 days later and the press found out that he, while employed, had asked for and received at least once emergency aid—R\$ 600 (around 115 USD monthly)—intended for people who lost jobs because of the pandemic. That request, too, led to an outcry²⁹.

The day before this event, another inspector, Jane Loureiro, had also been cursed and threatened with being fired³⁰. According to Loureiro, commercial establishments in the area

where she worked (a wealthy region in Rio) are more hostile: “They have always been more arrogant in the way they treat us. We have always suffered.” Again, her quotes that appeared in the media presented a frame of conflict between the economy and restrictions.

People came over saying that I was a bad person, that I was taking jobs from waiters, food from waiters' children, and that what I was doing was mean. One came up and said that his father was an attorney, that I was going to lose my job. It was very embarrassing and scary the level of aggressiveness of people.

This event generated 29 tweets or Instagram posts from 19 different influencers. Most of the posts addressed the conflict of a self-perceived elite claiming authority over public agents executing their duties. Interestingly, though, the post with the most “likes” was a fake video from Bolsonaro's son, Eduardo, comparing the crowded bars in the elite neighborhoods where the confrontations took place with a “baile funk” (a funk party) in the poorer Mangueira area of Rio³¹. This single fake item had more “likes” than the next nine posts combined. But it, too, led to comments about the conflict between elites and public agents. Felipe Neto, a digital influencer with more than 13 million

²⁹Globo (2020).

³⁰G1 (2020b).

³¹UOL (2020b).

followers on Instagram and 12 million on Twitter, acknowledged in the second most-liked tweet an anger toward the bourgeoisie. “They defeated me. I can no longer not wish to harm others after today’s images [of the disrespect] in Leblon. I failed as a human being.” Gregorio Duvivier, a humorist, described the situation as “the personification of bolsonarism in 13 s,” as he shared a video highlighting the snobbish phrases addressed to the health inspector.

The critical posts explicitly framed the events as being expressions of particularly Brazilian culture. Utilizing elements from discourse analysis, semiotics and Brazilian history, professor Debora Diniz posted on Instagram an analysis of the scenes, their connections to specific Brazilian behaviors, and how the impact on spread of the virus:

The Bolsonaro male supporter takes “citizen” as an offense. He has as his spokesman a person next to him who says “not just a citizen, a civil engineer.” Who were they talking to? To a health inspector who asked the couple to wear a mask on the streets. • The moment is like a vision for those who see human stupidity through a keyhole. It can be analyzed from politics to chauvinism, from female subordination to the mandonism patriarchy of Brazilian culture. To me, it is interesting to pause at the absurdity of those who are offended when the “citizen” speaks out to them. • To be a citizen is to be someone with rights. The body that screamed in response claimed that “a civil engineer [is] better than you.” It was not a black body or one from the peripheries. If it were, the way to claim power would be different: perhaps it would be just saying “hey, you.” That would be if there was just speech and not a physical blow. • It was a white body white-washed by its own values, magnified by the power of the country’s president who judicially disputes the obligation to wear masks. The anonymous and subordinate type reproduces, as in a herd, his master’s mantra: alienation³².

In this case, we see again the frames identified in earlier cases: individualism opposed to the collective good (individual liberty against local/state guidelines obedience); the expectations of the elite for superiority, in the particular Brazilian form called mandonism. Elio Gaspari, a well-known journalist, captured this point: “Cameras have become an effective remedy to combat those who fear democracy, those who are ready to pull rank on ‘the other,’ on people who they believe to be inferior. To ‘do you know who you are talking to?’ it is progress to respond with ‘do you know you’re being filmed?’”³³.

The Appellate Judge Who Humiliated a Municipal Officer in Santos After Refusing to Wear a Face Covering

The final example of disrespect for civil authorities also highlights the frame of a particularly Brazilian response to tensions between elites and civil authorities^{34,35}. On 18 July 2020, appellate judge

Eduardo Siqueira was caught on video excoriating a municipal civil guard in Santos, on the coast of São Paulo, after being fined for not wearing a mask while walking on the beach. The mask was mandatory in the city and violators subject to a R\$ 100 [around 18 USD] fine. The viral video shows the judge calling the municipal officer “illiterate” and trying to intimidate him by calling the Municipal Secretary of Public Security, Sérgio Del Bel. “Del Bel, I’m here with an illiterate, a Military Police Officer of yours here, a boy. I am walking without a mask. I’m just here on the beach. He’s here doing a ticket [against me],” said the judge on the phone. In the conversation, the judge insisted that the municipal decree does not have the force of law to compel residents to wear a mask. “I explained it again, but they [civilian guards] can’t understand it,” he said. When the call ended, Siqueira took the ticket, tore the paper, threw it on the ground and walked away.

The background helps highlight the elite vs. citizen frame. The officer, Cícero Hilário Roza Neto, 36, has degrees in public security and educational law. The diplomas, he said later, “only helped me do my job better.” According to Roza Neto, it was thanks to his upbringing and his education that he stood firm in the face of the worst insult he had ever received. “I was called illiterate. And I heard that from a very educated person.... He wanted to intimidate me in every way.” On August 25th, the National Justice Council decided to remove the judge and subject him to disciplinary proceedings³⁶. This case is very similar to the previous one: disrespect for a civil servant, the attempt to intimidate, drawing on the idea of mandonism.

Again the case drew lots of attention, with a clear peak in searches for “Appellate Judge” (*Desembargador*, in Portuguese). We analyzed 58 tweets from 26 different influencers. Only one influencer, the conservative representative Kim Kataguirí, defended the judge: “For me the wrong thing is the guard who, without having anything to do, instead of hunting a thief goes after a citizen (who was walking alone).” In contrast, Flávio Martins, professor of Constitutional Law, denounced the judge for receiving a wage (more than that of a Supreme Court judge) incompatible with his duty.

This case also showed the interaction of multiple frames and media: Átila Iamarino, the science communicator, had one of the most liked tweets when he promoted his own article in *Folha de São Paulo*. Titled “100 thousand deaths, and we are opening schools,” his article argued that “in order to open a school, we have to take measures and control the situation outside them”³⁷. He particularly criticized the attacks on public health and civic officials: “Deaths became less of a concern. Those who pay the bill for our strategy, or the lack of a strategy to combat the pandemic, are not the ones who decide. They are mere citizens who die. They are not judges, residents of Alphaville [a franchise of wealthy neighborhoods in large cities in Brazil] or engineers.” Iamarino also drew on the frame of incompetence, condemning the lack of official guidelines and measures. “We don’t have official pronouncements, we don’t have a Minister of Health, we don’t have contact tracking, we don’t have a federal strategy, we don’t have, we don’t have and we don’t have.”

³²“Debora Diniz on Instagram.” O Macho Bolsonarista Toma “Cidado” Como Ofensa. Tem Como Porta-Voz, Um Corpo Que Fala Ao Seu Lado. 2020. Instagram.com. <https://www.instagram.com/p/CCSHYUMFZ6A/>.

³³Gaspari (2020).

³⁴G1 (2020d).

³⁵Maia (2020).

³⁶Pauluze (2020).

³⁷Folha de S.Paulo (2020c).

Similarly, Monica Bergamo, another digital influencer with a presence in traditional media, drew on the frame criticizing the elites and mandonism. Sharing a post from another journalist, Fabio Pannunzio, Bergamo wrote: “Another idiot who thinks he is Napoleon Bonapart. A Judge who does not know that the law is for everyone. Imagine what this troglodyte does in case files.” Highlighting Judge Siqueira’s elite status, traditional journalists learned that he had been cited for the same issue in the past³⁸, that his salary was above the limit, and that the current judge of the São Paulo Court of Justice had sued him for injury and defamation in 1990.

Data Summary

Overall, we identified six recurring emphasis frames in the material we analyzed. Those frames are summarized in **Table 2**. Of the six, half appeared in two different categories of events.

As noted above, the data presented in **Figures 2–7** confirm that the general topics/keywords associated with the specific events were concentrated on those events.

DISCUSSION

Our goal in this study was to learn: (1) How traditional and social media in Brazil addressed the health measures associated with COVID-19? and (2) What kinds of different emphasis frames appeared in main media outlets, especially from key or influential actors during the pandemic? By examining some of the most prominent events during the first 6 months of the official pandemic in Brazil, we have documented the recurring tension between the President of Brazil, Jair Bolsonaro (and his supporters), and those who opposed him both politically and on health measures. In the process, we have identified a series of emphasis frames that recurred in both traditional media and social media:

- Tension between economic activity and health restrictions
- Incompetence
 - For some, this was the incompetence of those who did not believe in the danger of the pandemic
 - For others, this was the incompetence of WHO
- Violence
- Empathy (or lack thereof) for victims and health professionals
- Intolerance presented as a defense of the homeland
- Tension between elites and ordinary citizens.

An important aspect of this study was that we expected some of the emphasis frames to be particular to the Brazilian context. Although some studies of science communication have explored contexts outside of North America and Western Europe, we

believe that many more such studies are needed, to learn whether science communication concepts need to be expanded or modified as we apply them in new contexts.

As we don’t yet have many studies of COVID-19 science communication (save those in this special section, which we haven’t seen as we write this article), we leave to future analysis a more direct comparison of frames. But several of the emphasis frames we found stand out.

First, we know from our own reading of media worldwide that three of the emphasis frames have appeared elsewhere: the tension between economic activity and health restrictions, incompetence, and empathy. Future studies might want to explicitly compare how these emphasis frames appeared in different places.

Second, we know from some preliminary studies in the United States and China that the issue of nationalism and ethnic identity was present in many discussions of COVID-19 (Lu, 2020; Xi and Jia, 2020; Zhou, 2020). Thus, the emphasis frame we found of “intolerance presented as a defense of the homeland” is one we expect could be found in other contexts. This frame points to the role of national identity in science communication, an area that has not been well-studied.

Finally, two of the emphasis frames do speak to Brazilian issues. The extremes of inequality and poverty in Brazil, combined with a very high homicide rate, often lead to a perception of the country as violent and crime-ridden. Thus, the frame of violence, while perhaps not unique to Brazil, may have particular resonance there. Most clearly, we found that many articles and posts drew on the particularly Brazilian concept of “mandonism” in an emphasis frame highlighting the tension between elites and civilians. While neither of these frames is specifically Brazilian, their resonance and language again suggest that individual national contexts can play a role in science communication. Future studies should explore these contexts more carefully.

Overall, our study confirmed that although many emphasis frames likely appeared both in Brazil and elsewhere, some of those frames had specific cultural resonance in Brazil. This confirms our initial suggestion that studying responses to COVID in national contexts would show connections between the cultures of those nations and the local media responses. Obviously, our study only covers a fraction of a complex phenomenon. Available data, for example, did not allow us to connect traditional and social media coverage with public opinion data. Nor were we able to study the fake content circulated both on social media and through messaging systems such as WhatsApp³⁹. Our study was also limited because we do not know the demographic distribution of media and social media audiences, including differences of region or wealth.

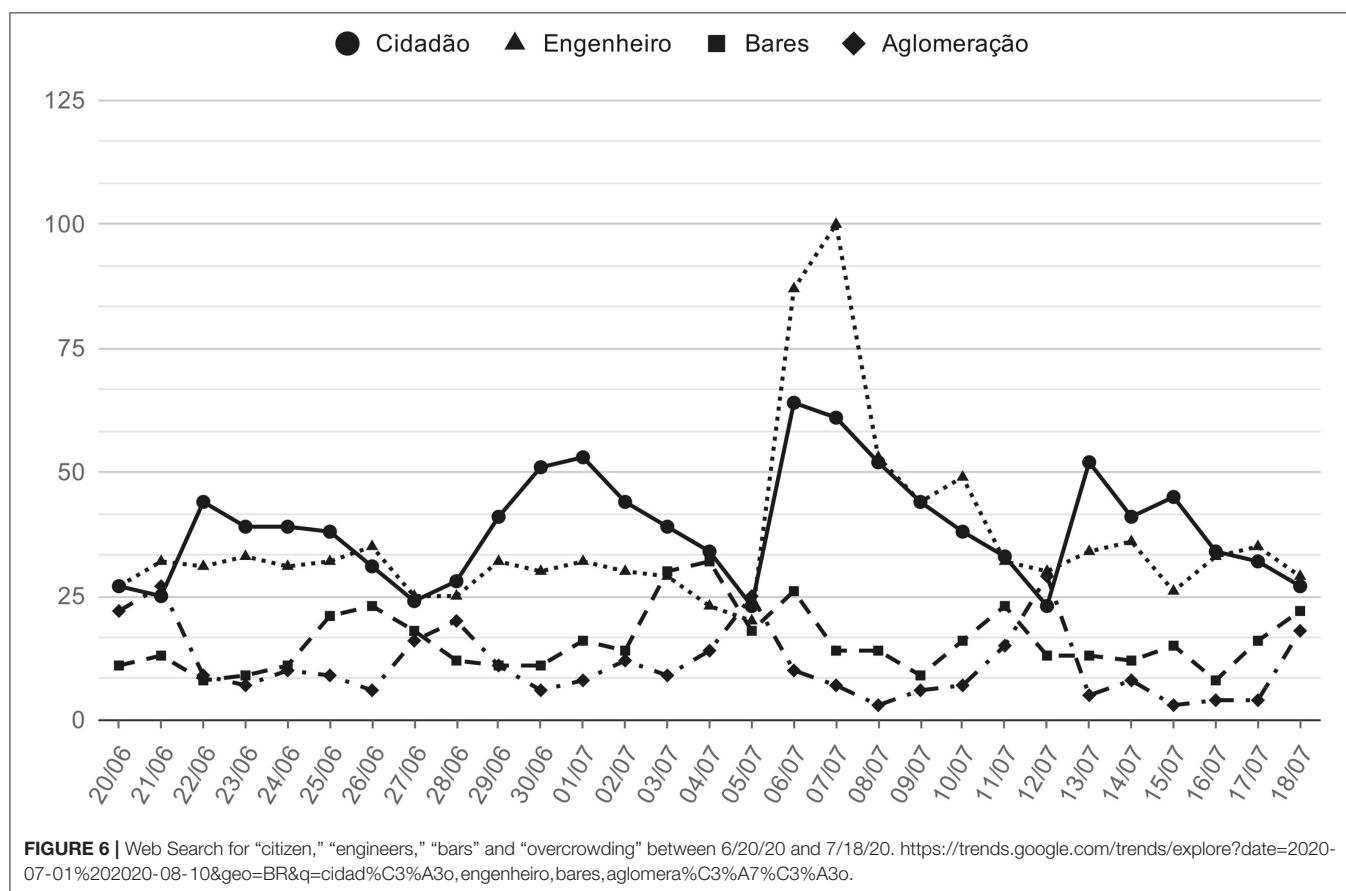
Nonetheless, our study helps illustrate some of the forces that let Brazilian authorities ignore established health measures, protocols, guidelines and science in responding to the pandemic. The inequality, racism, and authoritarianism that are fundamental to Brazilian culture are also directly opposed to what science communication aims to do: help humanity

³⁸In May, another Civic Guard asked the judge Siqueira to wear a mask. Siqueira got angry and affirmed that Santos City Hall would not have legislative competence over the city’s beaches. The guard explained that the intention was to make the population aware. “You are much more enlightened than all of us here,” said the officer, who is soon interrupted by the judge, who agreed (“Of course I’m!”) and began to speak in French, again, trying to diminish the authority of the Municipal Civil Guard. This second video also went viral in Brazil (G1, 2020e).

³⁹2020. Secom.Gov.Br. 2020. <http://whatsapp.secom.gov.br/whatsapp/>.

TABLE 2 | Emphasis frames in event categories.

	Official statements	Protests	Disrespect for civil authorities
Tension between economic activity and health restrictions	X		X
Incompetence	X		X
Violence	X	X	
Empathy (or lack thereof) for victims and health professionals		X	
Intolerance presented as a defense of the homeland		X	
Tension between elites and ordinary citizens		X	X



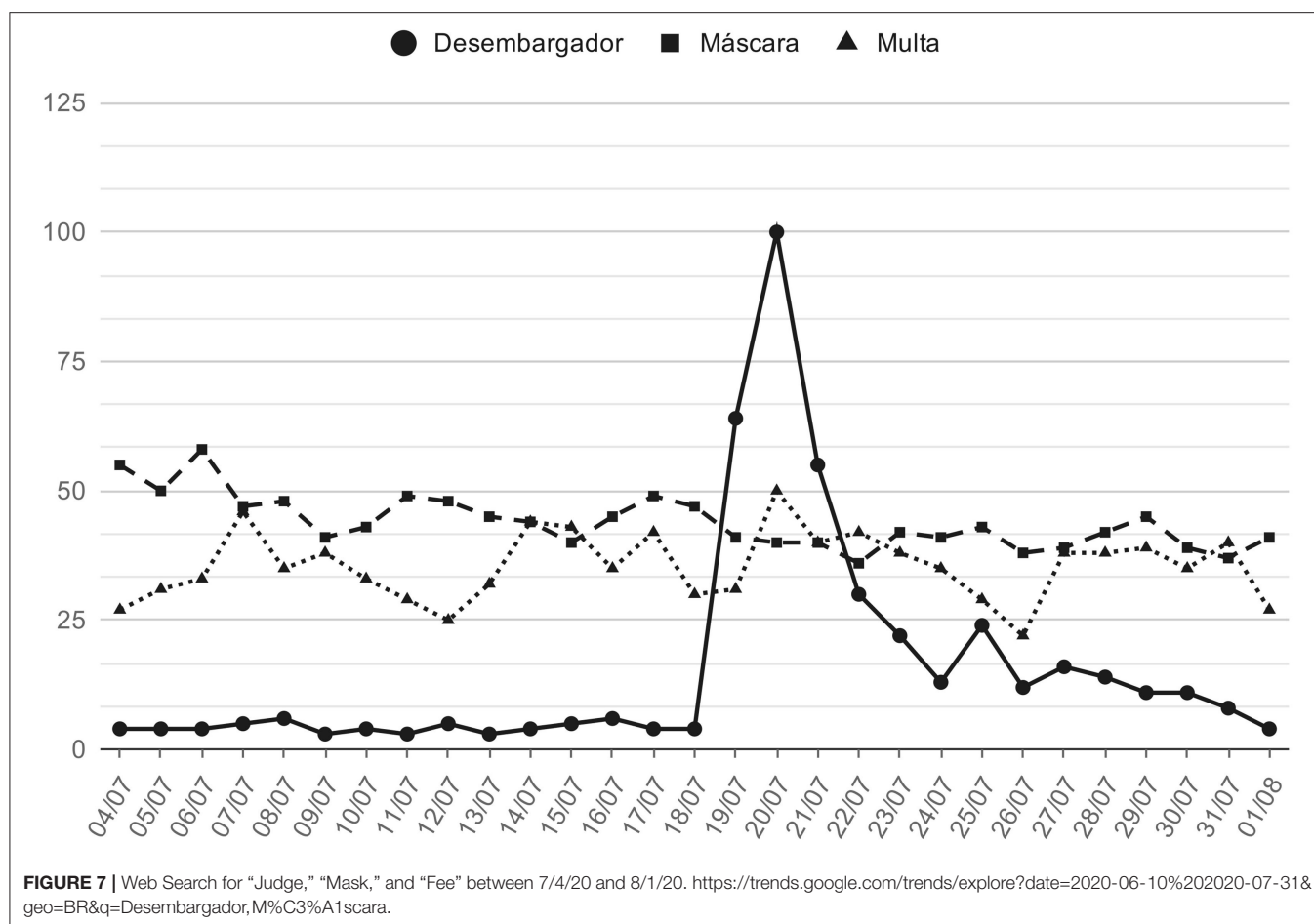
understand itself and its environment and find the best way to improve well-being.

By examining both traditional and social media, we can see how, since Bolsonaro's first speech, he, his sons, and their supporters used their strong presence on social media to undermine the key institution needed during the pandemic: official health organizations. Throughout the pandemic, starting in March and continuing past the time of our study, up through recent events (December 2020) when many countries have started vaccinations, Bolsonaro encouraged people to change their primary doctors if they refused to prescribe hydroxychloroquine, defended in court his right to not wear a mask in public, and provided support for patients who experienced side effects from vaccinations. In October, *Folha de São Paulo* reported a study from Universidade

Federal do Rio de Janeiro that compared information about the expansion of the disease with the result of the first round vote in the 2018 presidential elections in 5,570 municipalities⁴⁰. The conclusion: there is a correlation between the preference for President Jair Bolsonaro and the expansion of COVID-19. According to the survey, for every 10 percentage points more votes for Bolsonaro, there is an increase of 11% in the number of cases and 12% in the number of deaths.

The importance of understanding emphasis frames and their relationship with real-world outcomes is clear. Bolsonaro's strategy of questioning the severity of COVID-19 is working well for himself, but is a disaster for Brazil.

⁴⁰Garcia (2020).



A survey released on 13 December 2020 showed that Bolsonaro's popularity is at its highest level since the beginning of his term in January 2019⁴¹. Around 37% of Brazilians consider Bolsonaro's first term as “optimal” or “good.” His best approval rate is among employers, at 56%. At the opposite end, students disprove of Bolsonaro the most: 49%.

On 12 December 2020, data from DataFolha—the survey institute of the newspaper *Folha de São Paulo*—showed that 22% of respondents said they did not want a vaccine against COVID-19, while 73% said they will participate. The change is dramatic from a national survey in August 2020, which showed that only 9% did not intend to be vaccinated, against 89% who said they did. In all, 33% of Brazilians who say they always trust President Jair Bolsonaro said they will not get vaccinated, while that number drops to 16% among those who say they never trust the President⁴².

An important aspect of our findings is that the protests and the examples of disrespect were perpetrated by (and framed as actions by) those who saw themselves as an

elite, acting against those they considered as inferior people or groups. Both traditional media and social media directly tied these actions to Brazilian culture derived from the historical inequalities present since colonization and slavery. This elite/mandonism frame is linked to the emphasis frame that equated protests or law enforcement against Bolsonaro's perspective as an attack on Bolsonaro himself, and therefore as an attack on the homeland (this is despite the fact that the person or group demanding respect was often the group disrespecting and breaking the law, such as obstructing a legal and peaceful protest).

Our results also point to the importance of social media as a very powerful and influential tool for disputing political narratives. It is particularly noticeable, from a science communication perspective, that many of the highly “liked” influencers are professors or politicians with a scientific background—such as Debora Diniz (Social Service and Law), Jean Wyllys (Communication), and Marcelo Freixo (History).

Further research into the relations between science, disinformation and social media are necessary to understand the relationships among science communication, citizenship, democracy, and social justice. The pandemic—which is far from being over, especially in poor countries with

⁴¹Gielow (2020).

⁴²Amâncio (2020).

restricted access to vaccines—showed the costs of populism and deceit. We must learn how to use education and science-based information for all to avoid such suffering in the future.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2021.646445/full#supplementary-material>

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Chaos, Care, and Critique: Performing the Contemporary Academy During the COVID-19 Pandemic

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The starting point for this article is that the COVID-19 global pandemic has brought normally invisible, taken-for-granted aspects of contemporary societies into sharp relief. I explore the analytical affordances of this moment through a focus on the nature of the contemporary academy, asking how this was performed on “academic Twitter” in the early months of the 2020 COVID-19 pandemic, therefore contributing to work that has characterized contemporary university, research practice, and social media discussion of this. I draw on a dataset of tweets from academic Twitter, systematically downloaded between 1 March and 24 July 2020, that are concerned with the pandemic, analyzing these through a qualitative, multimodal, and practice-oriented approach. I identify themes of the disruption of academic work, of care and care practices, and of critiques of injustice and inequity within academia, but also argue that the ways in which these topics are instantiated—through distinctive repertoires of humor and of emotional honesty, positivity, and gratitude—are central to performances of academic life. The analysis thus further contributes to studies of communication to and by other publics, and in particular, the ways in which the content and form of social media communication are intertwined.

Keywords: social media, Twitter, academia, COVID-19, multimodality

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INTRODUCTION

I would like to start, if I may, with an anecdote from my own experiences during the early days of the pandemic in Europe. In Austria a hard lockdown came rather quickly into force: we went, it seemed, from vague concerns about other countries to a dramatic curtailment of movement in the space of a few days. In common with many others, my memory of those first days is of uncertainty, of rules and recommendations changing almost by the hour, and of a desperate search for new information. Those early hours, days, and weeks were marked by a dedication to media both new and old. Never before had I sat down deliberately to watch a government press conference; now, it was an event I planned my day around.

I was, both then and now, struck by the extent to which (my) sense-making was taking place through social media. This was a year in which the term “doomscrolling” (Markham, 2020) rose to prominence, and the notion perfectly captures my memory of obsessive scrolling through feeds in an effort to garner more knowledge, more certainty more collective meaning. Social media delivered local information (from the numbers of cases in my city to how to support local businesses), but it also showed how the global communities of which I am a part were making sense of the pandemic. Within my personal filter bubble (Pariser, 2011), academic jokes, stories, and debates were one aspect of this. Social media showed me how (some versions and parts of) academia were experiencing and defining this moment of crisis and change.

It was these experiences that led, in part, to this research, in that I became fascinated by what social media responses to the pandemic were revealing about academic cultures more generally. But the starting point for this article is not only my sense of social media as central to pandemic sense-making, but also a wider appreciation of the analytical affordances of moments of crisis or infrastructure breakdown. “The normally invisible quality of working infrastructure becomes visible when it breaks,” write Leigh Star and Ruhleder (1996), 113: “the server is down, the bridge washes out, and there is a power blackout. Even when there are back-up mechanisms or procedures, their existence further highlights the now-visible infrastructure.” Indeed, the COVID-19 global pandemic has brought normally invisible, taken-for-granted aspects of contemporary societies into sharp relief. In all its horror, the pandemic, its management in specific contexts, and public discourse on and responses to it have acted as analytical lenses through which the attitudes, practices, and values that underpin particular collectives—from nation states to specific institutions—can be rendered visible and therefore debatable. As many commentators have argued, the pandemic offers an opportunity to observe what is present and to suggest what might, and perhaps should, be otherwise.

In this article, I am specifically concerned with academic communities. In taking the pandemic as a moment of crisis in which taken-for-granted norms, assumptions, and ways of living are disrupted and therefore made visible, I seek to explore the nature of the contemporary academy as it was performed on “academic Twitter” in the early months of 2020. I therefore examine social media practices as a way of exploring the experiences of one particular public, that of academic researchers and teachers. In doing so, I build on previous scholarship in Science and Technology Studies (STS) and Higher Education Studies (HES) that has critically examined the ways in which academia is done in contemporary societies, from trends of marketization, massification, or internationalization to increased competition and precarity within academic careers. I am concerned with the following questions: How do scholars know and live in universities today? How are academia and the “good academic” performed, and how are these performances contested? What dynamics shape experiences of academia?

In what follows, I reflect on these questions through a qualitative, multimodal study of tweets from “academic Twitter.” I begin by outlining the literatures and conceptual sensitivities that frame the research, before describing the methodological approach taken. An extended empirical section describes three key aspects of the performances of academic life found within the data. I close by drawing my arguments together and reflecting on the wider implications of the analysis. What does it suggest more generally about academia, social media, and the COVID-19 crisis?

LITERATURES AND SENSIBILITIES

Life and Work in the Contemporary Academy

At the broadest level the question that animates this research concerns the nature of the contemporary academy, and what it is to live and work within it. It thus builds upon, and speaks to, a

now extensive body of multidisciplinary work that has sought to characterize university and research practice today. Key themes within this have included the “projectification” of research (Ylijoki, 2014; Fowler et al., 2015), an increase in precarity (Courtois and O’Keefe, 2015; Sigl, 2016; Bataille et al., 2017; Roumbanis, 2019), the implementation of entrepreneurial or capitalistic logics to academic practice (Slaughter and Leslie, 1997; Fochler, 2016; Reitz, 2017; Rushforth et al., 2018), the rise of narratives of “excellence” as one way of auditing academic practice (Lund, 2015; Watermeyer and Olssen, 2016), and demands for international mobility and other often punitive ways of living the “ideal academic” (Lund, 2015; Balaban, 2018). Much of this literature has thus been concerned, explicitly or implicitly, with questions of equity and diversity (Ackers, 2008; Leemann, 2010; Heijstra et al., 2017; Angervall and Beach, 2018), as it suggests that only some people can afford—financially, emotionally, or intellectually—to maintain an existence within academia as it is currently instantiated. Relatedly, it has been argued that the emotional tenor of academic life has become skewed toward anxiety and a sense of insecurity, and away from practices of care or support (Cardozo, 2017; Lorenz-Meyer, 2018; Ivancheva et al., 2019).

This is now a substantial and diverse literature, and one in which there are key disagreements (for instance, concerning the extent to which “neoliberalism” is a helpful framing of the changes that are taking place: Amsler and Shore, 2017; Ball, 2015; Cannizzo, 2018). I do not attempt to review it further here, instead highlighting one aspect that will be particularly pertinent to my discussion: that of the ways in which “living” and “working” are increasingly entangled within academic identities (Felt, 2009). Felt and others have argued that academics exist within “epistemic living spaces” in which the epistemic is mingled with, and enacted through, diverse social, symbolic, and material practices (Felt and Fochler, 2012; Linkova, 2013). Knowledge production, the crafting of a career or professional identity, and other ways of living are thus entangled. Similarly, accounts of academic careers have described the quite stringent work that is required to craft and protect an academic identity, from avoiding imposter syndrome (Taylor and Breeze, 2020) to successfully inhabiting an academic role (Campbell, 2003; Winkler, 2013; Schönbauer, 2020), while discussion of international mobility or of “jetsetter” academics have emphasized the all-encompassing nature of what is required of individuals (Zippel, 2017; Balaban, 2018). Living and working in the contemporary academy appear on the one hand to draw on well-established notions of a “vocation” or “calling” (Shapin, 2009; Berthoin Antal and Rogge, 2020), while, on the other, merging these with more recent expectations of entrepreneurialism, self-reliance, and individual responsibility (Hakala, 2009; Loveday, 2017). Academic identities are therefore performed in ways that mingle knowledge production with informal relationships, the personal with the professional, and the material with the symbolic (Davies, 2020).

Networked Scholarship and Academic Twitter

If the starting point for this research is the question of how life and work in the academy are currently articulated, then a second

frame is studies of how these academic lives are performed on social media. A growing body of work explores how academics make use of digital tools and platforms, from the use of online learning tools to academic social networks such as Academia.edu (e.g., Delfanti, 2020; Lupton et al., 2017). Within this, the work of George Veletsianos (Veletsianos, 2016; Veletsianos and Kimmons, 2012) on “networked participatory scholarship” has proven particularly influential. Veletsianos and Kimmons (2012), in the article that introduces the term, suggest that scholarship is changing through the emergence of digital tools; specifically, they write, “Networked Participatory Scholarship is the emergent practice of scholars’ use of participatory technologies and online social networks to share, reflect upon, critique, improve, validate, and further their scholarship” (p.768). This is not simply an amplification or development of existing practices. Rather, their contention is that academic practice is undergoing qualitative changes in ways that are entangled with digital technologies, including the emergence of new kinds of networks and of greater engagement with different kinds of audiences in and outside the academy. Thus, Veletsianos suggests, “paradigmatic shifts in and evaluation of our identity as scholars, the purposes of education and scholarship, and the academic preparation of scholars” (2016, 26) are underway.

One central aspect of this networked scholarship is the use of social media, and a number of studies have addressed the use of Twitter, in particular, by academics (Brantner et al., 2020; Gregory and Singh, 2018; Kimmons and Veletsianos, 2016). Stewart (2016), in an ethnographic study of academic Twitter users, argued that the platform “enables a collapsed space of engagement, wherein the analytic and text-based content of scholarship is shared *via* often-casual, participatory, and dialogic forms of exchange” (p.72). She charts the use of the platform not only for network-creation but for interactions involving intimacy, vulnerability, and care; as such, the now well-established notion of “context collapse” (Marwick and Boyd, 2011), where scholars may be subject to “unanticipated audiences and attention” (Stewart, 2016, 77), is a key risk. Other studies have shown, however, that academic users of Twitter are alert to these dangers and carefully manage their online presence. Self-disclosure, while potentially involving deeply intimate topics such as mental health or personal and professional challenges within the academy, is selective and tactical (Veletsianos and Stewart, 2016), while online identities are both “authentic” and “fragmented” (ibid; Jordan, 2020): social media users seek to present genuine expressions of the self, but spread across multiple platforms and designed for different audiences. While this work supports the notion of a sea change in academic practice—as Veletsianos and Stewart write, “scholars’ personal lives are often an integral part of online participation and as such mediate emergent forms of scholarship” (2016, 8)—more recent research has pointed out that opportunities to participate in such networked participatory scholarship are not distributed or experienced equally (Gregory and Singh, 2018). “Building an online academic presence,” argued Taylor and Breeze (2020), “is conditioned by the politics of class, race, and gender” (p.3). While Twitter appears to be a key site in which academics can perform identity work, for instance by rendering

underrepresented identities within the academy more visible (Veletsianos and Stewart, 2016), not everyone is able to (safely) do this in the same way.

Memes, Communities, and “Folkloric Expression”

While the work described above has explored, in some detail, how scholars use social media, there has been less systematic attention to the content of what they post, with the emphasis largely having been on individual negotiations and performances of academic experience.¹ In the context of this study, and of my interest in how academia is enacted, it is therefore important to draw on an adjacent body of work: that which has looked at the content of social media more generally, and specifically the “emerging patterns in public conversations” (Milner, 2018, 1) that can be identified within the rise of “mimetic media”: memes. Memes, Milner suggests, exist “in the space between individual texts and broader conversations, between individual citizens, and broader cultural discourses” (ibid, 2). They therefore offer an opportunity to explore the shared meanings held by (and sometimes contested within) particular communities.

Internet memes have been subject to academic study since at least 2014, when Limor Shifman defined the form as

- (a) a group of digital items sharing common characteristics of content, form, and/or stance, which
- (b) were created with awareness of each other, and
- (c) were circulated, imitated, and/or transformed *via* the Internet by many users (Shifman, 2014, 41)

As Shifman suggests, memes are both multiple—involving many versions of, for instance, an original image or text—and intertextual, in that they refer to other (online) content. Shifman and others distinguish memes (which are constantly tweaked, for instance, through mimicry or adaption) from virals (a single piece of content with high circulation); memes, then, are inherently communal, forming part of a wider conversation that implies a collective of people “in the know” (Philips and Milner, 2017). The slipperiness of memes is exactly that they travel outside of these implied communities, such that context collapse (Marwick and Boyd, 2011) is inevitable, their meanings are unclear, and the intention of their authors ambiguous. As Dynel notes, “online users’ voices behind their humorous memetic produce [sic] can never be established beyond any doubt” (2021, 191). Philips and Milner (2017) situate such communication as a form of “folkloric expression,” arguing that rather than being something dramatically new, memes, trolling, and other forms of internet ambiguity have many of the same features of folklore (the “lore” of any group with at least one thing in common; p. 25). As with folklore, mimetic expression is vernacular, informal, and simultaneously stable and conservative (referring to “tradition” and widely shared meanings) and dynamic and creative

¹See Veletsianos and Stewart, 2016 for one study of key themes within scholars’ “disclosures.”

(constantly adapted and remade by individuals). This perspective thus takes us again to understanding such communication as a set of practices that connect shared meanings with individual interpretations of these.

One further aspect of memetic media will be important for my discussion. Memes—like much of the rest of the internet environment—are multimodal, involving diverse communicative modes such as “word, image, audio, video, and hypertext” (Milner, 2018, 24). This, of course, renders them even more complex, as intertextual referencing, remixing, and adaptation can happen in one or several of the modes that they include (an image that tweaks another, or text that quotes or adapts lyrics or phrases; see Figure 1). It is important to note that this multimodality has also become important to virality: even text-only tweets are often captured with screenshots so that they can be circulated as images on other platforms. As I describe further below, I will primarily be focusing on textual content in my analysis, but will seek to pay attention to the ways in which this is situated and extended through other communicative modes.

MATERIALS AND METHODS

In describing work that explores the nature of the contemporary academy, networked scholarship, and memetic expression I have uncovered a number of conceptual sensitivities that will shape my analysis. I will, first, be interested in the ways in which contemporary academic life is performed, and particularly in the ways that these performances combine multiple facets of life, knowledge production, and work. Second, I am concerned with how such performances are done on Twitter, viewing academia-oriented tweets as the products of strategic and selective self-

presentations. Finally, I treat this social media material as a form of mimetic expression that both references wider community (ies) and shared meanings and involves individual creativity. While I am, as noted, interested in a set of general questions concerning contemporary academic experience (including how scholars know and live in universities today, how academia and the “good academic” are performed, and how these performances are contested), the specific question that structures the following discussion is: how was the contemporary academy performed on “academic Twitter” in the early months of the 2020 COVID-19 pandemic? In line with my interest in performativity and the enactment of community, I take an approach that is ethnographically oriented and qualitative (Marwick, 2013; Hine, 2015), viewing social media material as records of digital practices (Hepp et al., 2017) and thereby constitutive of what they describe. I therefore adapt techniques used for big data analysis of Twitter corpuses, such as bulk download of tweets (e.g., Brantner et al., 2020; Graham and Smith, 2016), in order to create a dataset that is suitable for in-depth qualitative analysis. As described below, the focus of this adaptation was on tightly delimiting the dataset (Dyner, 2021), an approach that allows for an in-depth but inevitably highly specific analysis.

I explore Twitter rather than other social media platforms for two reasons. First, academic Twitter offers perhaps the most consolidated online academic community, and is certainly the most studied (Brantner et al., 2020; Gregory and Singh, 2018; Kimmons and Veletsianos, 2016; Stewart, 2016; Veletsianos and Stewart, 2016). Second, it enables the collection of a coherent and clearly delimited dataset *via* the hashtags #AcademicTwitter and #AcademicChatter (in contrast to, for instance, Facebook, where there would be many relevant groups and users). The material I am concerned with thus consists of 1) tweets that 2) use the

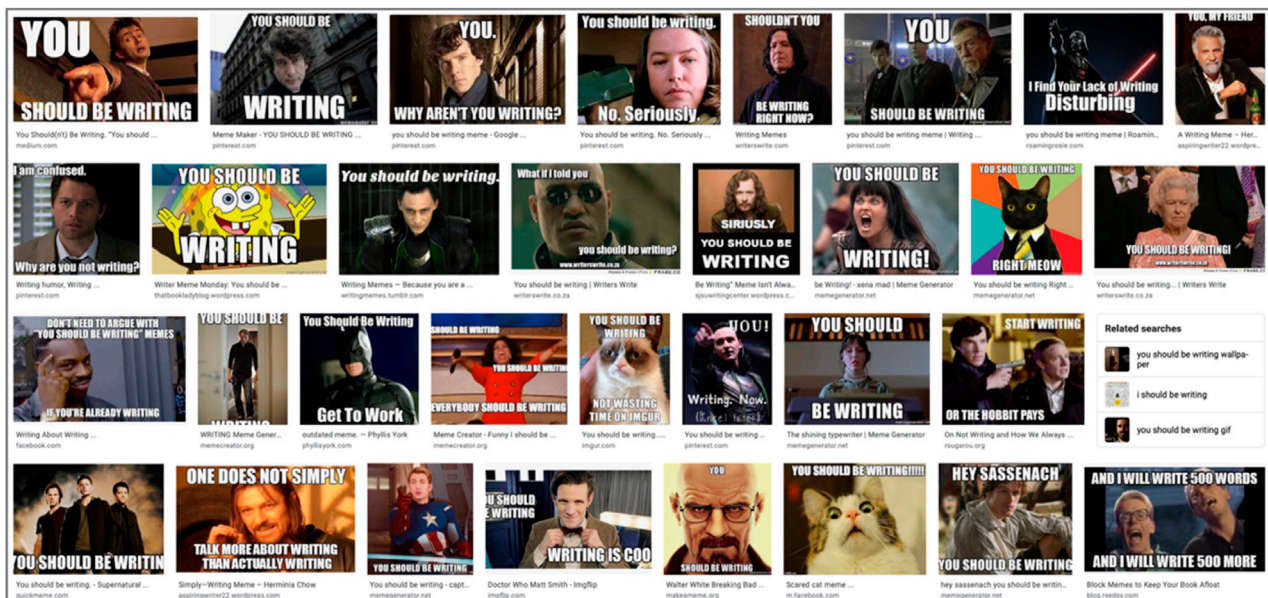


FIGURE 1 | Examples of memes; captured using the search term “You should be writing meme” and showing how both images and text are remixed in multiple combinations. “You should be writing” memes circulate within academically oriented social media but also in communities oriented to writing or study.

hashtags #AcademicTwitter or #AcademicChatter and were 3) published in the period March–July 2020, and 4) contain content (whether in the form of further hashtags or in the topics discussed) relating to the pandemic. This material has been gathered and curated in a number of steps. First, at the end of March 2020, I used Twitter’s search function to find tweets with the relevant hashtags, published in that month, which had been “favourited” 500 times or more.² Tweets that mentioned or related to the COVID-19 crisis were saved as screenshots. Second, using the tool Twitter Archiver,³ I set up an automated download of all tweets with the hashtags #AcademicTwitter or #AcademicChatter from 4 April 2020 onward.⁴ Of this material, I have incorporated tweets from the first month (4 April–4 May) with 25 or more favorites into the dataset, along with tweets from the next three months (4 May–24 July) with 500 or more favorites. The result is a corpus of tweets with hashtags #AcademicTwitter or #AcademicChatter from March (17), April (326), May to July (204), or 547 tweets in total across 5 months.

As the preceding description suggests, the dataset has been hand-curated to ensure both a quantity of material that lends itself to in-depth qualitative analysis (hence the decision to largely work with tweets with 500+ favorites, which are limited in number) and the capacity to capture key moments within the pandemic (the choice to include all tweets with 25+ favorites in April). In all cases, by working with tweets with 25+ favorites, the material has achieved some level of virality—here understood as being due to its reflecting shared experiences or opinions within the community of academic Twitter users, with high numbers of favorites seen as a sign of community approval (Graham and Smith, 2016). This process of curation was, of course, imperfect on multiple levels. The aim has been to create a corpus that captures widely appreciated tweets over the early months of the pandemic in numbers suitable for qualitative analysis (Dynel, 2021), but it can be problematized in multiple ways: by excluding hashtags such as #blackintheivory, #pandemicpedagogy, #PhdChat, and #PhDlife, for instance, key constituencies are partially excluded or rendered less visible in the material. It also misses academia-oriented content that used no hashtags at all. Similarly, the balance between producing a dataset that is manageable (focusing on more frequently favoured tweets) and capturing more of the discussion (including less popular tweets) over the course of the pandemic has been a difficult one. Ultimately, the material I work with cannot be seen as straightforwardly representative of online articulations of experiences of academia during the pandemic; rather, it captures key aspects of discussion between users of Twitter (a rather select population within academia more generally) who specifically identify or engage with the communities associated with the hashtags #AcademicTwitter and #AcademicChatter.

²Twitter users “show their agreement with or appreciation for a tweet by giving it an endorsement and ‘favoriting’ it” (Graham and Smith, 2016, 437).

³See: <https://digitalinspiration.com/product/twitter-archiver>

⁴Technical issues meant that there was a break of 3 days in data collection, between April 1 and 4.

Once compiled, the corpus was subject to two forms of analysis. I first carried out a thematic analysis (Rivas, 2018) of the material in order to identify repeated patterns and concerns, using the software MaxQDA as a means of organizing the material and developing a code scheme based on its content. I have, second, combined this thematic analysis with more focused exploration of multimodality (Machin, 2013) and with the conceptual sensitivities mentioned above, paying particular attention to how academia is (articulated as) lived in and embodied. In the discussion that follows, I use this second approach to explore particular tweets or aspects of the content in more detail, and to assess how particular themes are instantiated through social media practices.

It is important to note that working with Twitter data in this way raises issues relating to public space and ethical research. While early social media research embraced discourse on platforms such as Twitter as “public” and therefore as not being subject to the need for informed consent (Marwick, 2013), more recent scholarship has problematized this notion, pointing out that, while services such as Twitter explicitly state that “posts that are public will be made available to third parties,” many users assume some level of privacy or that their consent will be sought before tweets are used in research (Williams et al., 2017, 1150). Researchers have dealt with this in different ways, from following a decision flowchart where factors such as whether the tweeter is a “public figure” or deals with sensitive content shape the approach taken (Williams et al., 2017) to avoiding quotation entirely and instead crafting “autoethnographic fictions” that recreate how tweets might have been rendered (Taylor and Breeze, 2020). In this text, I use a variety of strategies. I avoid direct quotation as much as possible, instead discussing emergent themes and shared features of the corpus. I also paraphrase tweet content and describe, rather than including screenshots of, images and memes. Where I do quote directly, I do so from content that has been favoured thousands of times as well as frequently retweeted and replied to; such content, in my view, has become public by virtue of its popularity and reach. In all cases, I anonymize content and do not refer to specific users by name.

The next section presents the results of this analysis, describing and discussing three key themes that emerged from the data as central to depictions of academic life during this period: disruption, care, and critique.

PERFORMING THE ACADEMY ON ACADEMIC TWITTER

Disruption

To say that experiences of disruption, crisis, and chaos were a key feature of tweets about the pandemic risks banality. Notions of a break from normality and of dramatic differences from the expected or mundane were common across mainstream media and in political and policy discussion; indeed, as noted above, this disruption is what allows underlying assumptions to be identified. In this section, I thus explore not only tweet content concerning a sense of chaos and crisis but also what this tells us about “normal” life in the academy.

Particularly during the early stages of the pandemic in March, tweets frequently noted or alluded to the “unprecedented” nature of the current moment. This was, as one tweeter wrote, a “GLOBAL PANDEMIC” (caps in the original) and therefore an entirely new situation. Not only was this moment unprecedented but it was also “trying,” “tough,” or “difficult” in multiple ways. Themes of struggling and of the need to endure repeatedly emerged within the dataset, with, for instance, stories of students with close family members ill with COVID, the “emotional toll” of the situation, the challenge of dealing with constant uncertainty, or the sadness of defending one’s thesis at a time of social distancing. Tweeters spoke of struggling to concentrate, feeling despair or demoralization, or of mental health issues triggered by the crisis.

Such emotions and experiences were certainly not unique to academics. What was it, exactly, that academic tweeters described as being disrupted? Here key themes concerned the interruption of “normal” academic life through home-working, home-schooling, and care responsibilities, but also through the sudden removal of conferences and other face-to-face events such as defenses, the demand for online teaching, and ubiquitous Zoom meetings. Thus, on the one hand, some tweeters talked about the pleasures or affordances of quarantine and lockdown: one might use the time to finally finish the PhD thesis, or to catch up on reading. On the other hand, tweeters also asked for advice concerning disrupted fieldwork and the need to move to digital formats, made jokes about missing the lab, and worried about students who had “disappeared” since the move to online teaching. Much of this discussion was oriented to the need to the need to produce – particularly text, in the form of theses or articles, but also CVs, datasets, or good student evaluations. Concerns about an inability to concentrate, disrupted work days (for instance due to home-schooling), or a desire to “stay in my pyjamas all day,” “eat ice cream,” and “cry” all relate to an imagination of academic life as oriented to productivity. What was being disrupted by the pandemic, and the changed work practices it entailed, was the steady production of text and the capacity to “get more writing done.”

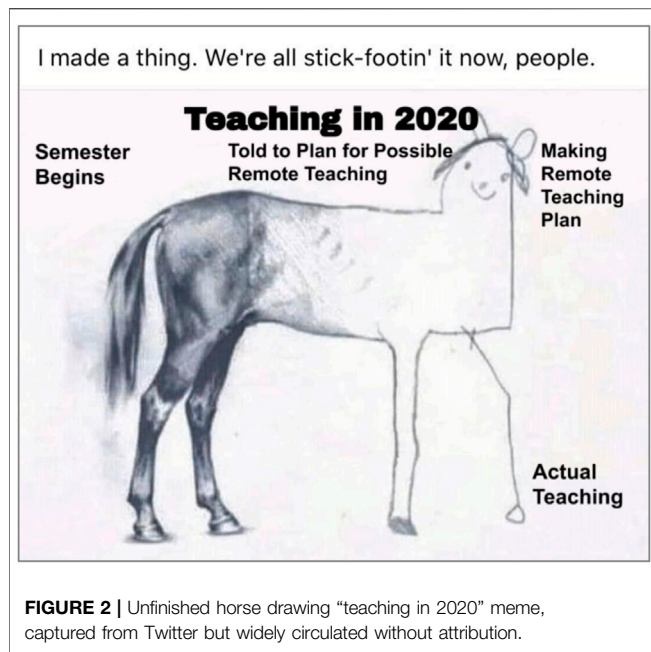
If the academy is enacted as oriented to productivity and the creation of text (in particular) within these tweets, it is also framed as being simultaneously solitary and social. It is this dynamic that lies behind the dual acknowledgment that much research (and more specifically, writing) is carried out alone (and that academics might therefore be somehow better prepared for the pandemic), but that it also involves important communal occasions (conferences, group meetings, and defenses). The pandemic was therefore described as simultaneously involving continuities with mundane academic life and as dramatically different from it. Tweeters joked about the PhD experience—limited human contact, the need for self-discipline, and digital communication—as being good preparation for lockdown, while also telling stories of efforts to replicate, *via* Zoom or other tools, social encounters such as discussions over coffee or conference attendance. The opportunity to participate in communal celebration—at the conclusion of a PhD or course, for instance—was particularly

missed. Here, as in other aspects of the material, there was a sense that face-to-face copresence was something intrinsic to academic life.

This material from academic Twitter thus enacts academic life as productivity-oriented and as simultaneously solitary and social. It is these features that were disrupted so violently by the pandemic: much of the anxiety and struggles that are described within the data come from interruptions of productivity—through additional care responsibilities, anxiety, or extra work connected to the pandemic, for instance—and from enforced changes in rhythms of solitude and copresence. Merely describing these themes, however, gives little sense of how they were enacted within tweets, and in particular the degree to which the use of humor to tell stories of disruption is key to these accounts. The themes described above were articulated in the form of jokes, humorous stories, and remixed memes as much as through straightforwardly descriptive text. The challenges of working from home, for instance, might be conveyed by a story about a child running in and asking to take their clothes off in the middle of a lecture, while disrupted rhythms are implied by joking questions about what day it is. Importantly, ideas about (lost) productivity were also conveyed in this way. One tweeter wrote that while they were impressed by people who were managing to finish articles or develop analyses during lockdown, all they had managed was a small-scale study of the relation between pandemics and wine consumption; another noted that with classes being canceled and university buildings closed, they would be forced to actually work on their dissertation. Such humor is an important feature both of the platform generally (Philips and Milner, 2017) and of this particular dataset. In referencing challenges in a lighthearted way, it reinforces particular imaginations of academic life—that productivity and professional demeanor are important, for instance—whilst also gently subverting them (showing that ideals are rarely lived up to, or that procrastination is as much an issue as lack of time).

Performances of the contemporary academy are thus instantiated through a humorous tone that does complex work in both reinforcing and subverting ideals concerning what academic life should look like. This point can be further illustrated by one popular meme, an academia-oriented adaptation of the “unfinished horse drawing” meme⁵ which was circulated in mid-March. This appears in this dataset as a screengrab of another tweet, and has been favorited almost 1500 times, but the meme also traveled to other platforms, rapidly losing its original attribution. As shown in **Figure 2**, it uses the “unfinished horse drawing” image (used in multiple other memes) as a basis for a depiction of teaching in 2020 and, in particular, the move to online teaching. The online meme encyclopedia Know Your Meme notes that memes based on this image convey “the feeling of being rushed through a task and express the feeling that something’s quality has diminished over time.” As such, its adaptation in the context of academic life

⁵See description on the Know Your Meme website: <https://knowyourmeme.com/memes/unfinished-horse-drawing>



and “pandemic pedagogy” communicates the disruption that has taken place and the drop in teaching quality that has occurred. It does so, however, in a manner that is humorous, highly visual, and self-mocking in the contrast between what is planned and what is actually carried out. The use of wry irony is typical of the humor that is deployed within discussion of pandemic disruption in this dataset, and of the ways in which even chaos and disruption are communicated through self-aware reflection.

Care

If a first key theme within this material is of articulations of chaos and disruption that are frequently conveyed through humor and ironic self-reflection, a second relates to care and care practices. Tweets in this dataset are not only oriented to funny stories about disrupted working practices. Just as frequently, the content seeks to express compassion, care, and emotional honesty, and to offer (or request) support, empathy, or advice. Tweepers thus frame themselves as being part of particular groups (faculty, PhD students, supervisors, and academics generally), offering mutual support to those communities and giving guidance for supporting others outside of them.

Students are one frequent object of these care practices. Many tweeters expressed concern or gratitude for their students, or advised others about how to look out for them. One tweet, from Mrach favoured several thousand times, asked readers to “check in regularly on your PhD students . . . Many (perhaps most) live alone with no family nearby. We supervisors are the closest they have to a family.” Others focused more on junior students, advising others to drop penalties for late assignments, be cautious that using COVID-19 in teaching might be triggering for some individuals, or find ways to maintain relationships with students despite the move to remote teaching. Students were thus viewed as a key population which was suffering from the effects of

the pandemic and which users of academic Twitter had the possibility to influence or support, whether by showing “kindness” or by trying to understand how to help individuals with little or no digital connectivity.

Tweepers also sought to care for “each other” and for “ourselves.” Articulations of care were directed within and between a community of academic Twitter users, with this community framed as being in need of compassion and care during the pandemic. Such articulations took different forms. Tweets might express offers of support (“we are here to support you”), discuss what it means in practice to “be kind to yourself,” remind people to check in on their friends and colleagues, ask for advice or for a “Zoom happy hour” because the tweeter was struggling, discuss the systems and structures in place at institutions to support well-being and mental resilience, or talk about how one was “staying sane” during such a difficult time (for instance, by painting or taking time off work). Such messages foregrounded the emotions tied to experiences of the pandemic, disclosing information about one’s own struggles and repeatedly emphasizing that it was normal to be finding the situation difficult. Tweepers thus both acknowledged negative emotions associated with the disruption described above, and affirmed that readers are “amazing and resilient” if they are managing to “survive.”

Care, in this material, is thus enacted as being vital to academia, but as often missing within it (cf. Cardozo, 2017; Ivancheva et al., 2019). The fact that so many of these tweets call for compassion and for care practices implies a backdrop where these are lacking or undervalued. Indeed, this is explicit within some tweets. One frequently favoured tweet discussed “the countless academics whose lack of compassion has consistently torn others down in the past few months,” and noted that this was more disappointing to them than their own, very natural, struggles. Similarly, the advice given—to check in on students or colleagues, to advise students that their mental health should be their priority, and to find things that help you “stay calm”—suggests that these practices are currently largely missing, and therefore need to be encouraged. Academic life is framed as requiring an influx of care through the mutual and self-supporting activities and practices the tweets promote.

Just as stories of disruption often came bundled with jokes and irony, expressions of care were instantiated through a distinctive affective repertoire. Here, memes and images were less important; instead, text (and sometimes Tweet threads, where several tweets are used to tell a longer story) was used to convey advice and support. The emotional tone of this content featured not only expressions of struggles or suffering and articulations of care and compassion in response to this but also gratitude, celebration, and motivational language. Thus, a thread of positivity ran through much of this content: tweeters wrote “props to other grads” who were similarly enduring difficult situations, that one needs to “survive to thrive” in “HARD” times, said “thank you” publically to colleagues or students, or gave “shout outs” to key individuals and groups. Similarly, academic Twitter was used as a key site to celebrate achievements (such as finishing or defending the PhD) or just enduring (even if one had not achieved anything, or were not pleased with your work, you should still consider yourself “excellent,” wrote one tweeter). As Veletsianos and others have

suggested, then, disclosure is a central feature of how academic Twitter is used (Stewart, 2016; Veletsianos and Stewart, 2016; Jordan, 2020). In this material, tweeters rarely complained about their situations, although they might express that they were finding them hard in particular ways. Instead, they expressed gratitude, gave themselves and others advice, shared encouragement or motivation, and asked for support. I discuss the one key exception to this in the section below.

Critique

While tweeters in this material rarely discussed injustice or unfairness at a personal level,⁶ or complained about their individual situations (though they might disclose that they were finding these challenging), a thread of critique did run through the dataset. This critique was rarely aimed at individuals; instead, tweeters drew attention to inequity and injustice within academia, and criticized the institutions, structures, or systems seen as responsible for these. Academic Twitter, in this dataset, was thus not only concerned with personal struggles or with care practices within a community of academic Twitter users, but with wider questions of equity and with academia's place within these.

The objects of this critique were institutions or groups such as “universities,” “faculty,” “this administration” (the Trump presidency in the United States), and “educators,” but also “us” and the “academic twittersphere.” Criticism or comment might also not be directed at any particular actor, but reflect on inequity without localizing blame to any specific site. The subject was, broadly, fairness or equity within the academy. Tweeters discussed, for instance, the different access students had to the technology that they now needed to access teaching, and their different home situations; the gendered challenges of working and teaching from home; cases where mainstream media focused on scientific work against COVID-19 by men, ignoring contributions by women; unfairness in how universities were treating their students and staff; and the ways in which casual or temporary academic staff were particularly badly affected by the situation. The discussion thus focused on the ways in which challenges (and opportunities) are differently experienced by those with different backgrounds and identities. As one tweeter wrote, “unearned privilege” was a central dynamic that structured how academics were able to deal with the pandemic and the demands it put on them.

This is well illustrated by a discussion that arose in response to a tweet by the celebrity scientist Neil deGrasse Tyson (Fahy, 2015). In a 1 April tweet that has been favourited 113,000 times (and which did not reference #AcademicTwitter or #AcademicChatter, and therefore does not form part of this dataset), deGrasse Tyson wrote that “When Isaac Newton stayed at home to avoid the 1665 plague, he discovered the laws of gravity, optics, and he invented calculus”: the point was, implicitly, that others stuck in lockdown situations might

use the time productively. The tweet appears in this dataset as a screenshot alongside the comment that Newton did not have to deal with online teaching, home-schooling, shortages of essential supplies, and other aspects of daily life in the pandemic for many academics. By suggesting that “staying home” was straightforward, resulting in empty time that could be filled with scientific work, deGrasse Tyson was ignoring the diverse and often difficult situations that people found themselves in, and the degree to which having such empty time was a product of resources (family members who might care for one's children, for instance, or a low teaching load). Other critique in this dataset was similarly focused on notions of productivity, which was seen as a key site where inequity became apparent. One tweeter wrote, addressing those anxious about their levels of productivity, that the pandemic “accentuates privileges” and that not everyone was able to be productive to the same extent, while another talked about the “duplicitous bullshit” of rewarding people who were managing to be particularly productive at a time of global crisis. Such comments relate to my earlier discussion of productivity—understood as the efficient and speedy creation of text or analysis—as central to enactments of the academy, but nuance and complicate this emphasis by pointing out that the ability to achieve this is in fact structured by unevenly shared privilege and opportunity.

By incorporating a thread of critique and attention to social justice, this Twitter material thus performs the academy as flawed not only through a deficit of care but also through its entanglements with and reflections of wider societal inequality. Particularly subject to criticism are university administrations and other institutional structures that demand productivity, a rapid switch to online teaching, or strict student attendance without acknowledging the barriers that some individuals and groups face in achieving this (from a lack of digital infrastructure to care responsibilities). While academics are themselves sometimes framed as complicit within this (hence the calls for “we,” the “twittersphere,” or “fellow researchers” to take heed of critique), the emphasis is on systemic factors that perpetuate historical privilege and on (flawed) university leadership. The academy is enacted as a place where an emphasis on productivity can all too easily be connected with a refusal to acknowledge unequal opportunities; this, in this material, leads to normative calls for institutions to act in more just ways, and for academics themselves—in the shape of the community that coalesces around #AcademicTwitter and #AcademicChatter—to be aware of injustice, show solidarity, and act in reflective and caring ways that seek to remedy or counter inequity.

DISCUSSION

To summarize, analysis of this dataset from academic Twitter during the COVID-19 pandemic has led to the identification of themes of the disruption of academic work, frequently instantiated through ironic humor and memes; of care and care practices, generally discussed in a language of emotional honesty, positivity, and gratitude; and of critiques of injustice and

⁶An observation which might in part be due to the methods used and in particular the decision to collect only tweets that had been favourited at least 25 times. More personal complaints may have resonated less widely and therefore achieved a lower level of virality.

inequity within academia, including (self-imposed) demands for productivity that ignore structural inequalities around who can achieve this. In this section, I want both to return to my research question—how was the contemporary academy performed on “academic Twitter” in the early months of the 2020 COVID-19 pandemic?—and to offer some more general reflections on the implications of these findings in the context of the literatures discussed at the start of the article.

How, then, was the academy performed within this material? As I have already started to sketch out, the version of academic life that is enacted within these Twitter discussions is one in which notions of “productivity” are contested but key. “Normal,” or perhaps rather “ideal,” academic life is one where it is possible to write, analyze, create datasets, read, or otherwise create knowledge products in effective and focused ways. Productivity is something that is constantly sought and that was disrupted by the pandemic. But this emphasis on production is neither taken for granted nor beyond criticism; indeed, a central focus of the critique that runs as a thread throughout the material is of the ability to produce being prioritized above well-being, mental health, or care for one’s community, and of unequal access to the possibility of such productivity. In this respect there are parallels with the literature that has analyzed the rise of “excellence” narratives within academia (Lund, 2015), discussed expectations of entrepreneurialism, self-reliance, and individual responsibility (Hakala, 2009; Loveday, 2017), or discussed current affective regimes of academic practice (Lorenz-Meyer, 2018). In such accounts, as in the material analyzed here, academics are expected to take personal responsibility for their careers, prioritizing the production of “excellent” research in order to ensure access to stable, long-term positions. Similarly, such work has also problematized ever-increasing demands to perform more and to perform better, and charted how these demands are being resisted or subverted by academics (Cannizzo, 2018; Rushforth et al., 2018). In this material, such resistance is done in part by an emphasis on care and care practices, an emphasis that has been hinted at in prior research (Cardozo, 2017; Heijstra et al., 2017; Ivancheva et al., 2019). By seeking to encourage care and “kindness,” these data enact the academy as fundamentally lacking in these things—a lack that is, at times, explicitly related to the emphasis on (personal) productivity. Similarly, the structural and institutional critique that appears on academic Twitter implies an academy that is unjust along multiple lines, and that demands intervention. The contemporary academy is performed as fundamentally flawed, both in its absence of equity and of care.

While this story of shortcoming and critique is certainly a key feature of this material, and one that is in line with other discussion of contemporary academia (Ball, 2015; Amsler and Shore, 2017), there are some complicating aspects. These emerge in particular from the ways in which these themes of productivity, deficiency, and critique are instantiated in the data, and the precise social media practices through which the academy is done. It matters, in other words, that the themes I have described are enacted through distinctive multimodal formats and through particular repertoires. It also matters that the academy is

performed within stories of disruption as not only oriented to productivity but also involving rhythms of social interaction and solitude. Opportunities for celebration and togetherness are framed as key to academic life, and as deeply missed when the pandemic renders them impossible. The academy, then, is communal as much as being about writing and producing. Similarly, themes of productivity are often conveyed through ironic humor or memes (such as the unfinished horse drawing meme discussed above, or the joke about a study of pandemics and wine consumption) that both reference and distance oneself from the practices or priorities described. Efficient production of knowledge products might be an ideal, but it is one that is rarely achieved, and this lack of achievement is a key feature of self-aware humor. Wry joking becomes a way of enacting both what is demanded and resistance to it, in the form of highlighting the impossibility of these demands. More than this, however, such humor itself performs a shared community, one that participates in the production and circulation of particular forms of mimetic expression, sharing “in-jokes” and thereby crafting a shared identity. What is being done on academic Twitter, through these practices, is the enactment not only of a specific version of the academy but of a community that reflects upon this academy, at times critiques it, and mobilizes a specific repertoire and style within its communications (humor, but also emotional honesty, gratitude, and positivity). Academic Twitter, we might say, performs not only the academy but also a counterpublic (Graham and Smith, 2016) that sits both inside (in that it is a part of it) and outside (in that it offers distance and critique) of it.

While this study adds weight to previous work that has outlined an increasingly pressured and precarious academy, then, it also adds new dimensions to this by suggesting something of the style by which academics inhabit this space. On this platform, at least, humor, articulations of care, and the crafting of communities of solidarity were central to life and work in the academy during the pandemic. It is these dynamics which could be particularly valuable lines for future research, enabling investigations which seek to nuance accounts of experiences of precarity or injustice (for instance) through examination of the tools and practices through which these are rendered meaningful and bearable.

CONCLUSION

In examining how the contemporary academy was performed on “academic Twitter” in the early months of the 2020 COVID-19 pandemic, I have argued that academic life is enacted in this material not only as oriented to productivity but also as involving rhythms of solitude and sociality, as lacking in care, and as often operating in unjust or unequal ways. At the same time, I have suggested that such a bald account misses much of the richness of the ways in which these performances are done. The use of humor, of registers of affect and solidarity, and of memes and other forms of multimodal expression all allow complex negotiations between acknowledgment of what one *should* be doing, and commentary on how things “really are.” Similarly, an

emphasis on encouraging and enabling care practices and on social justice assists in the production of (a shared imagination of) an academic community that exists within academe, but that seeks to counter toxic features of it.

How does this relate to COVID-19 itself? Certainly, my account has richly illustrated the ways in which institutions such as academia have had their values laid bare by the pandemic, and how accounts of disruption can allow us to identify norms and practices that are being disrupted. While academic Twitter is not, of course, representative of all experiences of the academy, the analysis nonetheless provides us with insight into the nature of life and work in contemporary universities. It also shows us how one particular community used social media to discuss, reflect on, and share experiences of the pandemic. Academics—specifically those who use #AcademicTwitter and #AcademicChatter on Twitter—are certainly not alone in using the platform to build community, share and seek advice, and articulate

struggles during ongoing experiences of COVID-19. I therefore hope that this analysis can contribute to studies of communication to and by other publics, and of the ways in which the content and form of social media communication are intertwined.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material; further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTION

The author confirms being the sole contributor of this work and has approved it for publication.

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Communicating the “Race” for the COVID-19 Vaccine: An Exploratory Study in Newspapers in the United States, the United Kingdom, and Brazil

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The search for an effective solution to control the COVID-19 pandemic has mobilized an unprecedented effort by science to develop a vaccine against the disease, in which pharmaceutical companies and scientific institutions from several countries participate. The world closely monitors research in this area, especially through media coverage, which plays a key role in the dissemination of trustful information and in the public’s understanding of science and health. On the other hand, anti-vaccine movements dispute space in this communication environment, which raises concerns of the authorities regarding the willingness of the population to get vaccinated. In this exploratory study, we used computer-assisted content analysis techniques, with *WordStat* software, to identify the most addressed terms, semantic clusters, actors, institutions, and countries in the texts and titles of 716 articles on the COVID-19 vaccine, published by *The New York Times* (US), *The Guardian* (United Kingdom), and *Folha de São Paulo* (Brazil), from January to October 2020. We sought to analyze similarities and differences of countries that stood out by the science denialism stance of their government leaders, reflecting on the severity of the pandemic in these places. Our results indicate that each newspaper emphasized the potential vaccines developed by laboratories in their countries or that have established partnerships with national institutions, but with a more politicized approach in Brazil and a little more technical-scientific approach in the United States and the United Kingdom. In external issues, the newspapers characterized the search for the discovery of a vaccine as a race in which nations and blocs historically marked by economic, political, and ideological disputes are competing, such as the United States, Europe, China, and Russia. The results lead us to reflect on the responsibility of the media to not only inform correctly but also not to create stigmas related to the origin of the vaccine and combat misinformation.

Keywords: vaccine, COVID-19, coronavirus, science communication, media coverage

INTRODUCTION

Vaccines are important achievements for public health not only for controlling or eradicating diseases but also for reducing health care costs and inequalities between countries (Andre et al., 2008). With 73 million cases and more than 1.6 million deaths in several countries by early December 2020 (Worldometer, 2020), the current COVID-19 pandemic required an unprecedented effort by science to develop a vaccine against the new coronavirus SARS-CoV-2. Until that same period, the World Health Organization counted 162 vaccine candidates in the preclinical phase (animal testing) and 52 in the clinical phase (human trials) (WHO, 2020a).

But just developing a vaccine is not enough for fighting a disease. Especially in a global health emergency, the vaccine must be available in all regions and, above all, there must be a willingness of people to get vaccinated (Schoch-Spana et al., 2020). This has been a challenge for authorities around the world, given the growing vaccine hesitancy (WHO, 2019) and the reverberation of anti-vaccine conspiracy groups (Hussain et al., 2018; Johnson et al., 2020).

In this regard, communication is an important tool for community engagement and social mobilization (Goldstein et al., 2015), and the media is one of the actors in this process (Quinn et al., 2020). With the advancement of the COVID-19 pandemic, the world closely monitors research for the development of a vaccine, especially through media coverage, which plays a key role in the dissemination of trustful information and in the public's understanding of science and health. Studies show that the media can have a crucial effect on risk perception and public protection behaviors (Chen and Stoecker, 2020; Vai et al., 2020).

To better understand how the media have treated this issue, we conducted an exploratory study to analyze the coverage of three major newspapers in the United States, the United Kingdom, and Brazil. At different times of the pandemic, these countries recorded the highest rates of infection and death by the new coronavirus (Worldometer, 2020) and stood out negatively for the science denialism stance of their government leaders (Pollock et al., 2020; The Lancet, 2020; Yamey and Gonsalves, 2020), which motivated us to analyze their similarities and differences.

BACKGROUND

A review by Catalan-Matamoros and Peñafiel-Saiz (2019) shows that traditional media coverage of vaccines has been the subject of research in the recent years. The authors identified 24 studies published between 2007 and 2017, mostly focused on the HPV vaccine. They also identified the predominance of articles from North America (United States and Canada) and the preference for analyzing print media (newspapers and magazines). Regarding the content, most found negative messages about vaccines in the media, which suggest that the current situation may reflect the public discourses that have been circulating for several years.

Meyer et al. (2016) noted that the most common risk messages in Canadian newspapers about the seasonal flu vaccine concerned its possible ineffectiveness, poor understanding of science about the vaccine, and the possibility that it could cause harm, including death. Another study of 250 internet articles on the HPV vaccine also concluded that comprehensive information about the immunizer, the viral infection, and its relationship with cervical cancer was limited (Habel et al., 2009). Therefore, such results show that these issues must be properly addressed, not only when there is a major health crisis.

Studies also suggest the correlation between news consumption and the adoption of certain behaviors. Chen and Stoecker (2020) estimated that every 100 additional media reports about influenza published in October in the United States between 2010 and 2017 were associated with an increase in the vaccination uptake rate of 0.3 percentage points among those aged over 65. This is an important point of attention in the COVID-19 pandemic, since the population was encouraged from the beginning to adopt basic hygiene measures to avoid contamination. A survey carried out in the early stages of the new coronavirus pandemic in Italy identified a crucial relationship between news consumption, threat perception, and the use of protective behaviors, such as social distancing (Vai et al., 2020).

The same is valid for the willingness to get vaccinated. In recent years, the decrease in immunization rates and the resurgence of vaccine-preventable diseases, such as measles, have made the WHO to list vaccine hesitancy among the ten threats to global health. According to the WHO, complacency, inconvenience in accessing vaccines, and lack of confidence are the main reasons for this situation (WHO, 2019). For Goldstein et al. (2015, p. 2), “where and who the messages come from is significant when lack of trust is a driver of hesitancy”. In this context, the anti-vaccine discourses and movements are gaining strength, with the fertile ground of social media for the dissemination of disinformation (Hussain et al., 2018).

An analysis of the complex network of activities of approximately 100 million individuals in Facebook between February and October 2019 revealed that, although in a smaller number, the anti-vaccination clusters become central in terms of positioning within the network, while pro-vaccination clusters are more peripheral (Johnson et al., 2020). Regarding Twitter, Wilson and Wiysonge (2020) analyzed more than 258,000 vaccination-related posts between 2018 and 2019 and estimated that a one-point shift upwards in the five-point disinformation scale was associated with a nearly two percentage point drop in mean vaccination coverage over the years. Twitter has even greater weight in the US and Brazil, as it is the social media actively used by the then President Donald Trump and President Jair Bolsonaro.

A review study by Puri et al. (2020) found that, in general, research has shown that anti-vaccine content often generates greater user engagement on social media. However, when analyzing the 100 most engaged hyperlinks between 2018 and 2019, Massarani et al. (2020) observed greater interest of Brazilians in favor of the vaccine but with the limited presence of content produced by academic and scientific institutions. In

addition, among the hyperlinks to texts with positions contrary to the vaccine, most contained false information.

Science denialism, which underlies anti-vaccine movements, also has a political element that has been reflected in the coverage of the COVID-19 pandemic. At the beginning of the crisis in the US, researchers noted that right-wing media outlets were more likely to make inaccurate statements about the origins and treatment of the disease, and people who reported consuming more of these news were later more likely to express misinformed opinions, such as a supposed exaggeration of experts regarding the severity of the pandemic (Motta et al., 2020).

Still in the early moments of the new coronavirus outbreak, Hart et al. (2020) verified an expressive presence of political actors in the US newspapers' coverage, in addition to a high degree of polarization in newspapers and television networks content. This last aspect was even more evident in the case of the COVID-19 vaccine, which mobilized the efforts of great world powers, such as the United States, the United Kingdom, Russia, and China, adding to the crisis elements of nationalism and global competition (Sanger et al., 2020).

As will be shown in the discussion of the results, in our view, political aspects are part of science, but the way in which these issues are addressed by the media can contribute to mitigate or strengthen prejudices. In the United States and Brazil, for example, people were less willing to get vaccinated with a vaccine originating in China or Russia (CPS, 2020; Kreps et al., 2020). This is a worrying scenario, since vaccination is considered more than individual protection, but one way to achieve the so-called herd immunity: the immunization of a large part of the population to reduce transmission and guarantee collective protection (Mallory et al., 2018).

MATERIAL AND METHODS

This exploratory study aims to analyze the coverage on the COVID-19 vaccine in newspapers in the United States, the United Kingdom, and Brazil. In addition to being strategic nations in their regions, these countries were chosen because they were marked by controversial government administrations regarding the outbreak (Pollock et al., 2020; The Lancet, 2020; Yamey and Gonsalves, 2020), including vaccination. Until the beginning of December 2020, the US, Brazil, and the United Kingdom were, respectively, the first, the second, and the sixth countries with the highest number of deaths from COVID-19 (Worldometer, 2020). Furthermore, we seek to advance in relation to the research on COVID-19 carried out so far by adding new national contexts and extending the period of analysis, contributing to updating the understanding of science communication during a major health emergency.

Although there is a tradition of studies on science communication in traditional media (Nisbet et al., 2003; Roche and Muskavitch, 2003; Dudo et al., 2007; Medeiros and Massarani et al., 2010), our choice for newspapers was also supported by a resumption of public attention in legacy media as reliable sources of information in the COVID-19 pandemic (Casero-Ripollés, 2020; Vai et al., 2020).

We selected elite newspapers in their respective countries, thus characterized by being historically consolidated commercial news organizations of national daily circulation and with a more balanced coverage in general (Lacy et al., 1991). Because they acquired credibility with the public and within the journalistic community itself, elite newspapers can also influence the coverage of other media outlets (Carpenter, 2007). We also looked for newspapers that made the full content available online, since we were interested in analyzing all publications. Thus, *The New York Times* (United States), *The Guardian* (United Kingdom), and *Folha de São Paulo* (Brazil) were selected.

For the composition of the corpus, we searched the three websites¹ for articles published between January 1 and October 31, 2020, with the keywords *vaccine* and *vaccines*, combined with the keywords *coronavirus*, *covid*, or *pandemic* (in English and Portuguese). As our objective was to analyze only articles which focused mainly on the vaccine, from this initial set, we selected those in which the word *vaccine/vaccines* appeared in the title. The final corpus resulted in 716 articles—339 from *Folha de São Paulo*, 199 from *The Guardian*, and 178 from *The New York Times*.

For the collection of texts, we used web scraping modules developed for the *Python* programming language. All content was stored in an *Excel* spreadsheet, from which the quantitative information of the corpus was extracted: number of articles published over the months, length, and distribution in sections. As it is a vast textual data, for an exploratory content analysis, we opted for a computer-assisted statistical processing, using *WordStat 6*, a text mining software from *Provalis Research*.

Big data analytics has been widely used in studies of large amounts of unstructured textual data, expanding the possibilities in social sciences research (Castelfranchi, 2017). One of the advantages is to be able to work with the full data, rather than using sample selections that can inevitably cause limitations and bias. In addition, the increase in data available on the Internet is accompanied by the development of quantitative and qualitative analysis tools (Cogburn, 2019) capable of exploring not only explicit aspects of the text but also its context, latent dimensions, and semantic aspects (Castelfranchi, 2017). This approach has already been used in studies on communication during health emergencies, such as the Spanish flu (Ewing et al., 2013), severe acute respiratory syndrome (Tian and Stewart, 2005), Zika virus (Wirz et al., 2018), and, more recently, COVID-19 (Liu et al., 2020).

In our study, for the set of articles in each newspaper, the following procedures were performed, adapted from Cogburn (2019): calculation of the most frequent words only in titles; calculation of the most frequent words in the body text; hierarchical clustering; and multidimensional scaling from the proximity and co-occurrence between words.

To calculate the frequency, both in body texts and in titles, we opted for the TF-IDF (Term Frequency weighted by Inverse Document Frequency). The technique is based on the

¹<https://www.nytimes.com/>; <https://www.theguardian.com/>; <https://www.folha.uol.com.br/> [Accessed December 18, 2020].

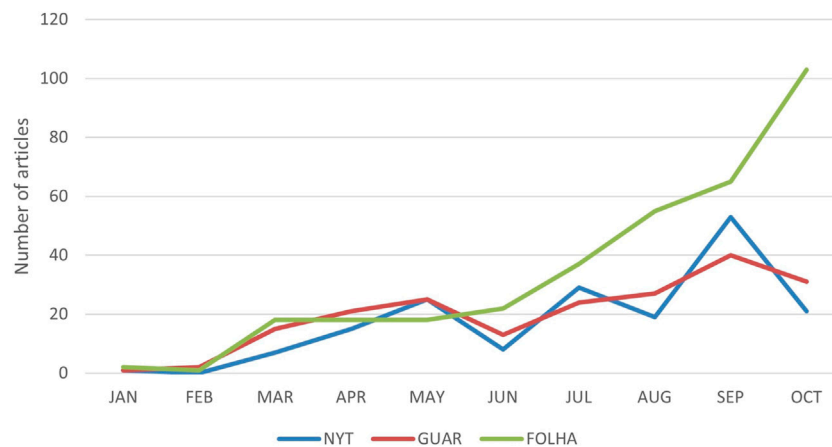


FIGURE 1 | Number of articles on COVID-19 vaccine published from January to October 2020 by *The New York Times*, *The Guardian*, and *Folha de São Paulo*.

assumption that the more often a term occurs in a document, the more it is representative of its content, but this importance needs to be weighed by the number of documents in which it appears (Provalis Research, 2010). According to Cogburn (2019), the calculation allows to identifying words considered more “important” in the corpus. The analysis of the body text corpus was made based on the 100 words with the highest TF-IDF. It was not necessary to define this limit in the title corpus, as the resulting set of words was smaller.

The hierarchical clustering is generated by the software by calculating a similarity matrix, based on the co-occurrence of the words, that is, whenever two words appear in the same paragraph. This option is most appropriate for identifying the co-occurrence of themes in individual subjects (Provalis Research, 2010). Multidimensional scaling is a way of visualizing this proximity on a map, with a graphical representation of the word distribution in the corpus. The map is useful to detect meaningful underlying dimensions that may explain observed similarities between items (Provalis Research, 2010). These tools contribute to detection of patterns in a big textual data.

In an inductive approach, from a first look at the results, we understand that our comparative analysis should focus on the actors, institutions, and countries revealed in these word lists and conceptual maps, since they were representative and revealing of the direction of the coverage of the three newspapers. Finally, to assist in the interpretation of the results, the software tools *keyword-in-context* (which shows all the articles in which a given word appears) and *proximity plot* (which displays a list of the terms that most appear next to a given word) were used. In the next section, we present the main findings, using articles from the corpus to illustrate the results.

RESULTS

General Coverage Characteristics

In the three newspapers, there is a trend for the COVID-19 vaccine articles to increase over time (Figure 1). This growth is

more constant in *Folha de São Paulo*, which reaches its peak in October, with 103 publications. *The New York Times* and *The Guardian* follow a similar pattern of attention to the issue, with a gradual increase until May and falling in June. From then on, the US newspaper mixes periods with more and fewer articles, with September being the month with the highest number (53). The British newspaper, on the other hand, resumes its upward trend until September, which is also the month with the most publications (40), and falls again in October.

Despite having published fewer articles, the texts of *The New York Times* are notably longer than the others, with an average of 1,285 words. *The Guardian* follows with 827 words on average. *Folha de São Paulo*, which produced the largest number of articles in comparison with the other two, is characterized by smaller texts, with an average of 699 words, which represents just over half of that registered in the US newspaper.

We also calculated the distribution of the articles by the sections of each newspaper. Although they adopt different nomenclatures, it is possible to note that, in January and February, the few articles related to a possible vaccine against the new coronavirus were published exclusively in the *Health* or *Science* sections. From March, the subject became much more distributed in other sections, achieving a wide variety of approaches, including *Politics*, *Economics*, *Opinion*, and even *Entertainment* and *Sports* sections. In *The New York Times*, the sections *Health* (65), *Politics* (23), and *Opinion* (16) were the ones that most addressed the topic². In *The Guardian*, the *World* section concentrated most of the articles (107), followed by *Opinion* (21) and *Society* (21). In *Folha de São Paulo*, the distribution was between *Balance & Health* (205), *Columnists* (51), and *Daily* (28).

Coverage Focus

The sets of the 100 words with the highest TF-IDF index in the body texts (Table 1) reveal that *The New York Times* and *The*

²The original names of the sections were kept.

TABLE 1 | Most frequent words in the body texts of *The New York Times*, *The Guardian*, and *Folha de São Paulo*, arranged by the TF-IDF value.

NYT	TF-IDF	GUAR	TF-IDF	FOLHA	TF-IDF
Johnson	141,2	Trial	118,6	Bolsonaro	202,7
Company	122	Trump	105,9	Virus	177
China	120,6	Anti	102,9	Vaccination	168,2
Trial	119,7	Australia	96,2	Millions	166,5
Trump	114,5	Trials	92,7	Production	157,1
Cases	114,2	Virus	88,1	Butantan	152,5
Pfizer	113,8	Fda	87,6	Phase	146,2
Dr	103,5	Countries	86,7	Doses	145,6
Novavax	100,8	Astrazeneca	85,1	Anvisa	145,6
Russia	100,6	Oxford	84,6	Ministry	142,4
Slaoui	100,4	Phase	83,2	President	139,6
Moderna	100,2	Immune	83,1	Volunteers	137
Children	97,3	China	82,6	Vaccines	134,5
Officials	96,9	United Kingdom	82,2	Doria	134,3
Inovio	96,7	Vaccination	81,6	Institute	132,6
Trials	94	Heeney	80,5	Government	128,8
Astrazeneca	92,9	Flu	79,3	Tests	127,8
Russian	92,8	Facebook	77,8	Studies	126,6
Phase	91,5	Doses	77,2	Country	125,9
Immune	89,2	Cases	75,3	Prove	125,9
Chinese	89	Global	74,4	Study	125
Stock	87,1	Public	74,4	Russia	121,9
Researchers	86,5	Research	74,3	People	121,2
Intelligence	85,5	Eu	74,1	Technology	121,2
State	84,9	Challenge	74,1	Adenovirus	120,8
Countries	84,3	Government	73,1	Results	120
Volunteers	81,2	Russian	73	coronavac	119
Percent	81,1	Russia	72,7	Data	116,9
White	80,7	Cells	72,4	Antibodies	116,2
Wednesday	80,3	Home	71,1	Countries	116,1
Government	79,9	Human	70,8	Oxford	115
Students	79,8	Volunteers	69,4	Brazil	114,3
House	78,7	Cell	68	Answer	114,1
Doses	78	Gavi	67,3	Company	113,9
Federal	77,6	Testing	66	Clinical	112,7
Million	77,5	Company	66	Cells	112,6
Flu	76,8	Bn	65,9	Safety	110,6
Antibodies	76,5	Companies	64,7	Minister	109,1
Djokovic	76	Clinical	64,3	Efficacy	108,8
Vaxart	75,8	Sars	64,1	China	108,5
Cells	75,5	Safety	63,6	Actions	107,1
City	75,5	Vaccines	63	Population	106,7
Data	75,1	Scientists	62,7	Paulo	105,9
Country	75	Risk	62,4	Immunization	105,8
Companies	74,4	Development	62,1	Bcg	105,8
Polio	73,3	Team	61,8	Purchase	105,2
Scientists	72,8	Country	61	Research	104,5
Tuesday	72,8	Access	60,7	Health	104,4
Virus	72,6	Drug	60,3	Humans	104,1
Barouch	72,6	Response	60	Disease	103,6
Speed	70,1	Pharmaceutical	59,7	Agency	103,1
Agency	70	Infection	58,7	Sinovac	103,1
Challenge	69,9	Pandemic	58,6	Sputnik	102,4
Participants	69,5	Protein	58,1	astrazeneca	101,7
Department	69,5	Data	58,1	Researchers	101,1
Public	68,6	Study	58,1	State	100,4
Emergency	68,4	Days	58	R	100,1
Care	68	Work	58	Development	98,6
Patients	68	Manufacturing	57,9	Sars	98
Week	67,4	Economic	57,7	Fiocruz	97,8
Institute	66,7	Year	57,5	Chinese	97,1
Billion	65,6	Told	57,4	Immunizing	95,7
Parents	65,5	Covax	57,4	States	95,5
Reported	65,5	Health	57,3	Case	94,8

(Continued on following page)

TABLE 1 | (Continued) Most frequent words in the body texts of *The New York Times*, *The Guardian*, and *Folha de São Paulo*, arranged by the TF-IDF value.

NYT	TF-IDF	GUAR	TF-IDF	FOLHA	TF-IDF
People	65,2	Safe	57,1	Pazuello	94,6
Day	65,2	Disease	57	New	94,3
Study	64,9	Months	56,7	Cov	94,1
Warp	64,8	Morrison	56,5	Federal	93,9
American	64,1	Groups	56,4	Immune	93,3
Information	63,5	Article	56,2	University	92,9
Covid	63,3	Candidates	55,6	Use	92,4
Monkeys	62,7	Fauci	55,5	Obligatory	92,3
Ms	62,6	Effective	55,4	Foundation	92,1
System	61,7	Produce	55,1	Essay	92,1
School	61,4	Process	55	National	91,6
Results	61,3	Cepi	54,9	Governor	91,4
Process	60,8	Minister	54,6	United States of America	91,2
World	60,6	Administration	54,5	Russian	91,1
President	60,2	Group	54,4	Cases	91
Placebo	59,9	Johnson	53,7	Risk	90,9
Guidelines	59,8	State	53,5	Obligatoriness	89,7
Protein	59,7	Ensure	53,4	V	89,3
October	59,3	World	53,3	Partnership	89
Administration	59,2	Social	53,2	Us	88,6
Election	59,1	End	53,2	Rna	88
Americans	59	States	53	Laboratory	87,9
Lockdown	58,7	Candidate	53	World	87,8
Risk	58,5	System	52,9	Organism	87,6
Research	58,2	Nhs	52,6	Coronavirus	87
Studies	58,2	Approved	52,3	Register	86,8
Year	57,4	Symptoms	51,9	Who	86,5
Approval	57,4	Make	51,9	Immunity	86,4
Clinical	57,1	Diseases	51,7	United	85,6
Global	56,9	Election	51,4	Participants	85,4
Tested	56,8	National	51,3	Rio	85
Vaccination	56,8	Long	51,1	Effects	84,7
Operation	56,7	Csl	50,9	Scientists	84,6
Measles	56,4	Participants	50,9	Dose	83,8
Canada	55,6	Day	50,5	Phases	83,7
Tests	55,5	Australian	50,5	Pharmaceutic	83,2

Guardian's coverage focused on the trials conducted by pharmaceutical companies for the development of a COVID-19 vaccine. This approach also appears in *Folha de São Paulo* with reference to the testing phases, although there was an emphasis by the Brazilian newspaper on the prognosis to produce a possible immunizer (*production, doses*). A particularity of the British newspaper was the frequent references to the anti-vaccine movement, generally mentioned as obstacles to disease control (*US anti-vaxxers aim to spread fear over future coronavirus vaccine—The Guardian, 5/29/2020*).

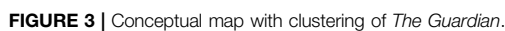
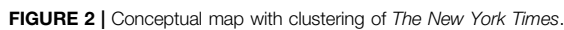
The way this content was distributed can be visualized on the conceptual maps (**Figures 2–4**). The circles represent the most frequent words and are differentiated by the size (the larger the circle, the greater the frequency of the item); by the distance from each other (the closer, the greater the tendency to occurring closer in the texts); and by the color (each color represents a cluster). The images show coverage of several subjects in the same cluster in *The New York Times* and more delimited topics in *The Guardian* and *Folha de São Paulo*.

In the US newspaper, a single cluster dominates the corpus, gathering governmental issues and technical and scientific aspects related to the tests and research conducted by

companies in the country. The other terms are not enough to form well-defined clusters. In the British newspaper, the clusters on the left portion show the division of coverage between the internal context (cluster 1), focusing on the research of the pharmaceutical company AstraZeneca and the University of Oxford, and the external context (2 and 3), which includes China, Russia, and Australia. Technical and scientific issues form well-defined clusters on the lower-right portion (4, 5, and 6).

The same pattern of content distribution can be observed in *Folha de São Paulo*, with the internal references in two clusters on the left (1 and 2), related to political discussions on production, in Brazilian scientific institutions, of vaccines developed by the companies Sinovac (China) and AstraZeneca/University of Oxford (United Kingdom). The cluster on the lower-central part (3) highlights discussions about the obligation to take the vaccine.

The right portion shows two well-defined clusters (4 and 5), which gather technical and scientific terms related to tests, immune response, safety, and efficacy. The external context appears in two clusters: on the upper-central portion (6), bringing together Brazil, the United States, and China and on



words *safety* (Vaccine makers keep safety details quiet, alarming scientists—*The New York Times*, 9/13/2020), *potential* (Coronavirus: the four potential vaccines bought up by United Kingdom—*The Guardian*, 7/29/2020), and *obligatory* (This vaccine will not be obligatory, period—says Bolsonaro about CoronaVac—*Folha de São Paulo*, 10/19/2020).

In the three newspapers, the word *race* is also among the most used in the headlines, such as: *Profits and pride at stake, the race for a vaccine intensifies* (*The New York Times*, 2/5/2020); *Five organisations in the race to develop a coronavirus vaccine* (*The Guardian*, 5/18/2020); and *Vaccine race confronts China and USA*

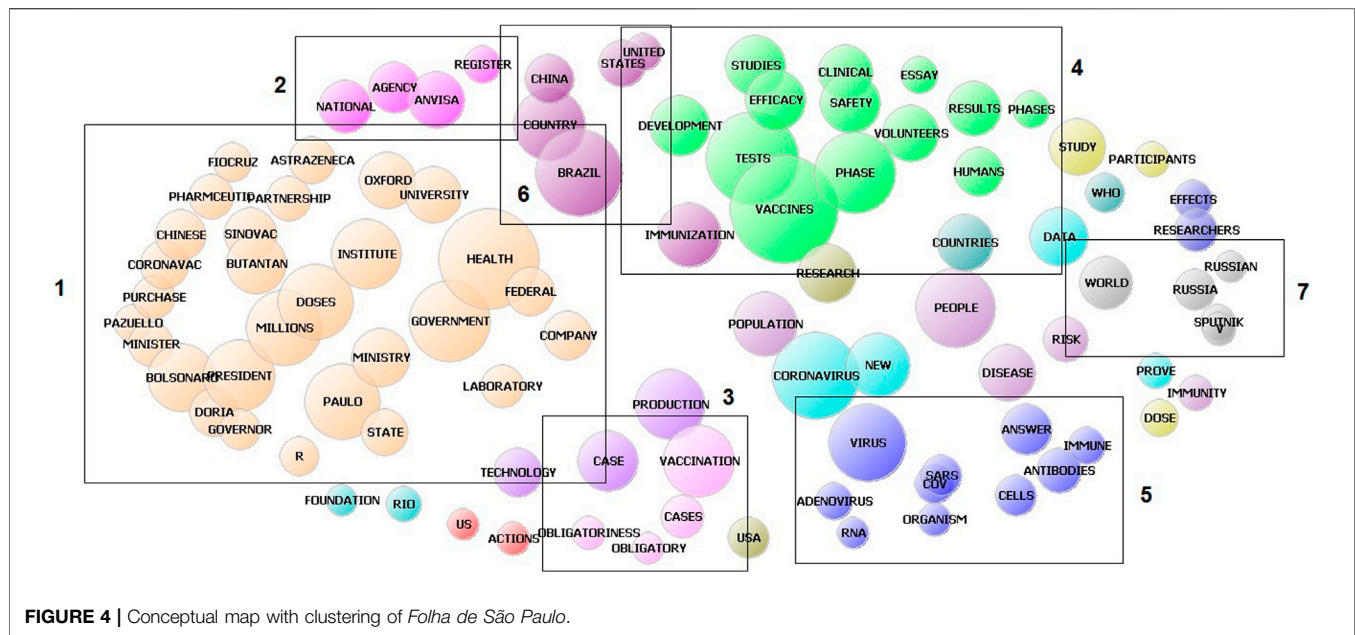


FIGURE 4 | Conceptual map with clustering of *Folha de São Paulo*.

TABLE 2 | Most frequent words in the titles; and most frequent actors, institutions, and countries in the texts of *The New York Times*, *The Guardian*, and *Folha de São Paulo*.

	The New York Times	The Guardian	Folha de São Paulo
Titles	Coronavirus, vaccines, covid, trump, race, safety, trial, virus vaccine	Coronavirus, covid, UK, oxford, trial, vaccines, trump, race, trials, potential, doses, world, vaccine	Against, covid, coronavirus, vaccines, vaccine, bolsonaro, Brazil, tests, oxford, anvisa, doria, vaccination, Chinese, USA, production, Russia, health, race, test, announce, China, government, obligatory, Russian, sp, study
Actors	Trump, Saloui, Djokovic, Barouch	Trump, Heeney, Morrison, Fauci	Bolsonaro, doria, Pazuello
Institutions	Johnson&Johnson, Pfizer, Moderna, Novavax, Inovio, AstraZeneca, Vaxart	FDA, AstraZeneca, Oxford, Gavi, Covax, CEPI, Johnson&Johnson, NHS, CSL	Butantan, Anvisa, Ministry [of Health], Oxford, sinovac, AstraZeneca, Fio Cruz, WHO
Countries	China, Russia, Canada	Australia, United Kingdom, China, European Union, Russia	Russia, Brazil, China, United States of America

again (*Folha de São Paulo*, 4/17/2020). These examples also illustrate some of the actors that appear in the coverage (world powers and their companies) and the interests mobilized (profits and pride).

There is little emphasis on the name of institutions in the headlines. The University of Oxford is the only institution named in the title corpus, in the headlines of *The Guardian* and *Folha de São Paulo*. However, it is necessary to pay close attention to the option of the Brazilian newspaper for the adjectives *Chinese* and *Russian* to refer to the vaccines produced in these countries, to the detriment of the name of the respective companies, or research institutes (*How is the 'Chinese vaccine' going around the world and in Brazil—Folha de São Paulo*, 10/17/2020; *Russian vaccine research for COVID-19 has been surrounded by secrecy—Folha de São Paulo*, 8/11/2020).

International Players

Finally, we identified the countries, actors, and institutions that appear among the 100 words with the highest TF-IDF in the body texts. China and Russia are the countries that emerge frequently in the coverage of the three newspapers (Table 1). The first

country appears with great prominence in *The New York Times*, being the fourth most important word in the corpus. Russia comes in the 12th. The positions between these two countries are reversed in the Brazilian and British newspapers, where they appear a little less accentuated, but still relevant.

Besides being countries that are undergoing research into the development of vaccines, China and Russia appear in the coverage due to accusations of cybercrime (*US to accuse China of trying to hack vaccine data, as virus redirects cyberattacks—The New York Times*, 5/10/2020; *United Kingdom '95% sure' Russian hackers tried to steal coronavirus vaccine research—The Guardian*, 7/17/2020).

Once again, *The Guardian* pays special attention to Australia and, somewhat less, to the European Union. With a much lower degree of importance, the United States and Canada appear in *Folha de São Paulo* and *The New York Times* corpus, respectively.

Actors Involved

Among the actors with the greatest prominence in the coverage, the name of the then president of the United States, Donald

Trump, appears in the first top ten not only in *The New York Times* but also in *The Guardian*, even more prominently than in the US newspaper (Table 1). It is interesting to note that, among the 100 words with the higher TF-IDF in the British newspaper corpus, the name of Prime Minister Boris Johnson does not even appear. *The Guardian's* attention to the American situation is reinforced by reference to Doctor Anthony Fauci, a leading American infection-disease expert. In *Folha de São Paulo*, the name of the president of Brazil, Jair Bolsonaro, presented the highest index of importance among all words.

Still in this aspect, the Brazilian newspaper concentrated its coverage basically on government figures: in addition to the president, the governor of São Paulo, João Doria, and the Minister of Health, Eduardo Pazuello. In the other two newspapers, there is a greater diversity of actors, with representatives of the scientific field, such as Moncef Saloui (scientific adviser of Operation Warp Speed), Dan Barouch (Beth Israel Deaconess Medical Center), and Jonathan Heeney (University of Cambridge).

The coverage of *The New York Times* and *The Guardian* also features characters explored in depth, but in more punctual articles. In the US newspaper, tennis player Novak Djokovic emerges as a denialist voice of the sport, with anti-vaccine discourse and having promoted a match at the height of the pandemic (*Novak Djokovic on coronavirus, vaccines and his ill-fated Adria Tour—The New York Times*, 8/20/2020). *The Guardian's* frequent mention of the name of Australia's Prime Minister Scott Morrison can be explained by the fact that the British newspaper has an edition aimed at that country.

Companies and Institutions

The pharmaceutical companies appear in greater quantity and importance in *The New York Times* (Table 1). In the 100 most frequent terms based on the TF-IDF, there are no mentions of institutions of another nature by the newspaper. Its coverage referred to seven laboratories with vaccines under development, six of them in the US and only one based in the United Kingdom. The other newspapers included public science and technology institutions and universities that work in partnership with pharmaceutical companies, and government agencies linked to public health.

In *The Guardian*, the institution with the most importance in the corpus is from the US—the Food and Drug Administration (FDA). But it is noteworthy that the British newspaper is the only one that devotes some attention to international vaccine development initiatives, such as the Global Vaccine Alliance (Gavi) and the Coalition for Epidemic Preparedness Innovations (CEPI), which participate in Covax, an agreement to guarantee equitable access to vaccines against COVID-19. When referring to these initiatives, some articles from *The Guardian* deal with the problem of equity in the distribution of the vaccine globally (*How will the world's poorest people get a coronavirus vaccine?—The Guardian*, 6/24/2020). The World Health Organization appears only in the *Folha de São Paulo* corpus.

DISCUSSION

Global Media Attention

The COVID-19 pandemic caused an exponential increase in news production and consumption. Liu et al. (2020), in the Chinese context, and Casero-Ripollés (2020), in the United States, verified that this growth occurred as the crisis worsened in the respective local scenarios. In the specific case of the vaccine articles published by *The New York Times*, *The Guardian*, and *Folha de São Paulo*, the coverage intensifies as of March, coinciding with the pandemic declaration by WHO (WHO, 2020c).

There are differences in the number of articles published by each newspaper, but considering the length of the texts, it is possible to state that the three of them provided similar amounts of content. The word distribution in the corpus of each newspaper, revealed in the concept maps (Figures 2–4), is an indication of their editorial choices and the way the news reaches the public in the three countries: topics covered simultaneously in the US newspaper and a more pronounced division of subjects in the British and Brazilian newspapers, but all of them monitoring the issue from the internal and external perspectives.

In any case, the presence of vast online content in these important newspapers is consistent with the pre-pandemic study by Mukerjee et al. (2018). The authors analyzed the US and the British media coverage on the 2016 American presidential election and the 2016 Brexit referendum, respectively. The conclusion was that the two networks exhibited a cohesive core, essentially formed by legacy news outlets, which still stand as the main sources of news online.

The increased interest in the vaccine news can be explained by the fear and anxiety caused by a disease that spreads rapidly, causes deaths, and that, without effective treatment, has in the vaccine the hope of a solution. Another study based on these same newspapers, but focusing on news about preprint scientific articles, sustains this perception by revealing that the research most addressed in these articles had, as the theme, the search for treatment (*drug trials*) and the identification of antibodies in the population (*seroprevalence*) (Massarani and Neves, n.d., in press). The aforementioned study by Liu et al. (2020), which analyzed more than 7,700 articles from Chinese media outlets, also identified the media's predominant focus on *prevention and control procedure and medical treatment and research*.

The Race Metaphor

The results also show how the health crisis gradually stops being a subject restricted to specialized coverage in science and health and starts to cover other sections. In the list of most frequent words (Table 1) and on the maps, there are several scientific terms that go through all the coverage, composing the daily lexicon of the readers. This highlights another characteristic of the COVID-19 pandemic: in the current stage of development of communication technologies, for the first time in history, a pandemic is accompanied by the media uninterruptedly, which includes monitoring research and testing for the development of a vaccine.

The New York Times and *The Guardian*, for example, launched a Coronavirus Vaccine Tracker (Kommenda and Hulley-Jones, 2020; Zimmer et al., 2020). The panels, which indicate the number of immunizers in each phase of testing being researched around the world, are the visual representation of the *race* for the vaccine discovery—a word often used in the articles' titles in the three newspapers (Table 2). Faced with a lucrative and competitive pharmaceutical industry, this is not only a metaphor for speed but also for competition: in a race, whoever gets ahead wins.

The coverage reveals that in the case of the COVID-19 vaccine, the competition is formed by pharmaceutical companies, scientific institutions and, in a more symbolic way, by the countries they represent. Thus, some vaccines are identified not by their laboratory but by their nationality—an aspect that cannot be ignored when the interests of nations and blocs historically marked by economic, political, and ideological disputes are at stake, such as the United States, Europe, China, and Russia. Some articles even position the “competitors” in the dispute: *In race for a vaccine, an Oxford group leads ahead* (*The New York Times*, 4/27/2020); *Russia claims to be ahead of rivals in race to produce COVID vaccine* (*The Guardian*, 8/3/2020); *China “leads race” for vaccine, with two in “final stage”* (*Folha de São Paulo*, 7/7/2020).

The presence of these references in the headlines strengthens the risk of a rapid, incomplete, or biased seizure of the content. This is because the titles are essentially brief elements that need to attract the reader's attention (Condit et al., 2001). In addition, it is worth remembering that newspapers are inserted in social media platforms and the sharing of their news often occurs only from the title (Massarani et al., 2020). Condit et al. (2001) showed that access to the content of a text is essential for the reader to adjust the interpretation of misleading information in the title.

Meaning Construction

We comprehend that all these aspects mentioned so far are inherent to the social dimension of science and, therefore, need to be discussed in the public sphere. But it is necessary to reflect on the meanings that can be constructed from certain media approaches, especially in countries such as Brazil and the United States, where conspiracy theories were driven by their own leaders, whose names appear prominently in the coverage of the respective newspapers. President Donald Trump, for example, was criticized for referring to the new coronavirus as a “Chinese virus”, giving the disease a racist sense (Rogers et al., 2020).

According to Habel et al. (2009), the way the vaccine is labeled in the news can have an impact on the public's perception and, consequently, on the decision to take it. A survey shows that the Brazilian's intention to get vaccinated decreases by 16.4% if the vaccine is associated with China and 14.1% if associated with Russia (CPS, 2020). The number of Brazilians who do not intend to get vaccinated increased from 9 to 22% between August and December 2020 (Datafolha, 2020). In the United States, a study found that a vaccine originating in China was associated with a 10% lower willingness to receive in contrast to one developed in the US (Kreps et al., 2020).

In the United Kingdom, 21% of survey respondents said they were unlikely to get a COVID-19 vaccine and 12% were unsure (YouGov, 2020). McDonnell (2020) states that this percentage does not indicate high levels of anti-vaccine opinions in that country, but the theme has nevertheless received significant attention from *The Guardian*. Movements against vaccination are not recent, but have gained more visibility in the current pandemic (Catalan-Matamoros and Elías, 2020). The anti-vaccine movement is already engaged in the dissemination of misinformation about the COVID-19 vaccine (Quinn et al., 2020) and has its spokespersons sharing inconsistent and contradictory information, as in the case of the sportsman mentioned in *The New York Times* coverage.

Scientific and Political Actors

The major presence of governmental and scientific actors and institutions in our corpus is in line with the result obtained in the review article by Catalan-Matamoros and Peñafiel-Saiz (2019) and by Catalan-Matamoros and Elías (2020) when identifying the sources used by the Spanish press on vaccine stories. However, our study records different incidences according to the newspaper analyzed: more focused on local political and government actors in *Folha de São Paulo*, and on scientific sources and institutions in *The New York Times* and *The Guardian*.

It is verified that the presence of these names in the Brazilian coverage is not simply linked to the choice of sources but to the repercussion of discussions about the origin of the vaccine and the mandatory vaccination in the country, led by political opponents. President Jair Bolsonaro even declared that he would not buy a vaccine from a Chinese company, even though the governor of the state of São Paulo—the most populous in Brazil and one of the most affected by the pandemic—had already signed an agreement with the Sinovac laboratory for the vaccine manufacturing (*Bolsonaro talks about betrayal and says he will not buy Chinese vaccine—Folha de São Paulo*, 10/21/2020). The Chinese company began testing volunteers in Brazil in July 2020, in partnership with the Butantan Institute, an important Brazilian public scientific institution.

It is not by chance that the word *obligatory* appears among the most frequent in the headlines of *Folha de São Paulo*. The results of the other newspapers suggest that the political aspect has been mitigated. In addition to a slight diversity of actors in the US newspaper, the focus is on the word *safety*, while in *The Guardian* the use of the word *potential* to qualify vaccines demonstrates a caution when addressing the subject. The British newspaper covered the international perspective extensively, with great attention to the American and Australian situations, characteristic of the nature of the newspaper itself, which divides its content into four editions: United Kingdom, United States, Australia, and International.

The presence of political actors in the news, especially in Brazil, is indicative of politicization in coverage (Chinn et al., 2020), which is not necessarily negative (Hart et al., 2020). Again, the problem is when the “politicization of science” prevents the adoption of scientific adaptations that would benefit most people (Bolsen et al., 2014) and reaches worrying levels when decisions

imply consequences involving public health and people's lives, such as vaccination. Moreover, the results suggest that the coverage focus of the three newspapers seems to have left other issues in the background, as shown by the little presence of WHO and the limited discussion of social justice in accessing the COVID-19 vaccine by countries.

CONCLUSION

This exploratory study allowed us to identify the general characteristics of the coverage of three important newspapers in the United States, the United Kingdom, and Brazil on the development of a vaccine against COVID-19, contributing to the understanding of the relationship between communication and science in a public health emergency. The use of computer-assisted text analysis techniques made it possible to examine a significant volume of articles published over ten months. We consider that the selection of newspapers from countries characterized by the high incidence of the disease and the controversies involving the management of the crisis was also a differential for allowing a comparative analysis of more varied geographical and economic perspectives, in order to fill a gap identified by Catalan-Matamoros and Peñafiel-Saiz (2019) in relation to the locus of research on this theme.

In general, when focusing on internal issues, each newspaper emphasized the potential vaccines developed by laboratories in their countries or that have entered into partnerships with their national institutions, but with a more politicized character in Brazil and a little more technical-scientific in the United States and the United Kingdom. The external issues brought together the three media outlets, which characterized the search for the discovery of a vaccine as a race in which major world powers participate.

In comparison with previous studies on other vaccines, our analysis suggests that the severity and duration of a health crisis like the COVID-19 pandemic may have contributed to broadening the media's approach to vaccine development,

especially in two aspects—in the technical, with a more detailed coverage of the testing phase and the technologies involved in the research of an immunizer; and in the geopolitical aspect, addressing political, economic, and ideological dimensions that are also part of science.

Such results gain even more relevance since previous research has shown that the media can contribute to the public's perception of health issues, including the decision to get vaccinated. Aware of this, research institutions and scientists have advised on the best communication practices related to vaccines, such as transparency, clarity, dialogue, training, and use of reliable sources (WHO, 2020b; Quinn et al., 2020; Schoch-Spana et al., 2020). Therefore, the media must also be fully conscious of its responsibility not only to inform correctly but also not to create stigmas and combat misinformation.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

Both authors contributed to the study conception and design, data analysis, and article writing.

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Visual Representations of Science in a Pandemic: COVID-19 in Images

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This article aims to contribute to the understanding of the social dimensions of the 2020 pandemic, with a particular emphasis on the visual practices of science communication in times of health emergency, by analyzing how the coronavirus disease-2019 (COVID-19) pandemic is being visually represented. It seeks to identify the format and content of images used to illustrate online information about the pandemic, in particular, from websites of policy institutions, research promoters, and media in Portugal and Spain. By examining a sample containing 600 images, it aims to identify the messages being conveyed and the effects these images intend to provoke and to illuminate the differences in representations among the three sources of communication. Differences and similarities with visual images of previous pandemics (influenza, AIDS) are examined. This article ascertains that policy websites aim to be mostly prescriptive, relying on infographics to convey prevention and care instructions to its audiences. On the other hand, science websites rely mostly on stock photos and images from scientific articles to illustrate current research, while newspaper websites are the most diversified in terms of the images they use and the topics they cover. This study concludes that representations of science are still very much based on stereotypical imagery of labs and white coats, that representations of the medical side of the pandemic are focused on images of intensive care that aim to generate fear and stimulate responsible behavior, and that the social aspects of the pandemic are illustrated by images that focus either on pandemic prevention (e.g., washing hands) or on the impacts of the pandemic itself (e.g., empty streets during lockdown).

Keywords: laboratory, virus, hospital, photograph, infographics

INTRODUCTION

The coronavirus disease-2019 (COVID-19) pandemic has brought science to the forefront of the international public sphere. Never have so many newspaper articles been written, so many press conferences held, and so many minutes of television news broadcasted in such a short amount of time about a microscopic virus and the science dedicated to investigate it.

The pandemic has generated its own peculiar images. Doctors are hidden behind extensive protective gears, row upon row of intubated patients in hospital intensive care units, nervous officials presenting the tally of the day for infected and deceased, empty streets in usually busy cities, and masked citizens queuing for the supermarket in addition to graphs and maps charting the unstoppable progression of the disease, hunched scientists on laboratory benches rushing to produce reliable tests or effective vaccines, and the virus itself, a colored blob covered in menacing nail-like spikes.

Thus, how is the COVID-19 pandemic being represented visually in media, government, and academia? What arguments are being conveyed by the images? What aspects of the pandemic do these images give visibility to? Are there differences in representation among these three sources of communication? Which points of view are being showed and which are being omitted? Are there differences between the COVID-19 visual images and those of previous pandemics (influenza, AIDS)?

This study will focus on Portugal and Spain, two countries with quite similar backgrounds (scientific, social, economic, and political) but with fairly different experiences with the pandemic: the first wave was far milder in Portugal than in Spain, but that was not the case with the second wave, although the mortality rate is still higher in Spain. At the time of writing, Spain has a cumulative incidence (after 292 days) of 3,687.01 cases per 100,000 inhabitants, while Portugal has a cumulative incidence (after 286 days) of 3,354.22 cases per 100,000 inhabitants. Mortality figures are more distinct: 54.09 per 1,000 inhabitants in Portugal and almost double (101.46) in Spain [Source: COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, Dong et al., 2020].

Science communication often relies on images to convey its messages. A great deal of literature has dealt with the role of images in the dissemination of scientific knowledge among peers (Latour and Woolgar, 1986; Cetina, 1999) and in the communication of science to the general public. According to Davies and Horst (2016), “no matter what the content is, images, graphics, and visual representations are a vital part of almost any kind of science communication, from news stories to public lectures. Communicators often take it for granted that they will use visuals in their work, and it is standard advice to scientists that they should produce images or graphics to help them explain their research.” Accordingly, some authors have focused on visual representations of science in the media (Lewenstein, 1995; Jarman et al., 2012), while others have focused on the need for visual literacy by communicators and audiences for effective science communication (Trumbo, 1999; Bucchi and Saracino, 2016). Desnoyers (2011) created a typology of images in science communication. Some studies concern visual representation in particular disciplines (Nerlich, 2008) or scientific topics (O’Neill and Smith, 2014). Portraits of scientists and science in popular media are also frequent subjects of analysis (Cho et al., 2009).

Hentschell (2014) discusses the transfer of chromophotography, film recording and interactive simulation from the realm of science production to science popularization, with changes in meaning and simplification. He gave the use of scientific icons in the advertisement as an example: “it is often just a metaphorical transfer onto a commercial product of desirable attributes such as high reliability or laboratory precision. For this purpose only well-known icons of science are chosen—the stereotypical scientist (a wizened male, sometimes with the unkempt Einstein hairdo and wearing protective goggles) functions as a guarantor of proven quality.” (Hentschell, 2014, p. 258–259).

However, the use of images for science communication is not neutral. Cetina (1999) coined the word “viscourse,” in analogy to the discourse of Foucault, to denote the elaborate lattice of

visual interconnections between “images and their contexts of presentation, usage, and critique” (Hentschell, 2014, p. 262). Haraway (1991) considered scientific images as objectivizing gazes that aim to be neutral and objective but, in fact, highlight some points of view and obscure others. For Davies and Horst (2016), images show one truth among several, are produced and interpreted in particular cultural contexts and are used to put forward arguments and persuade audiences. The visual communication of medical sciences and medical issues has its own specific characteristics, from representations of the human body to medical imaging, and from public health posters to medical devices and instruments (Jordanova, 2013).

MATERIALS AND METHODS

With the purpose of collecting a sample of images that could epitomize the most common visual representations of the pandemic, we retrieved images from three types of websites in the two countries:

- Government health departments: the Ministry of Health in Spain, the Directorate-General of Health, the National Health Service, and a dedicated COVID-19 webpage of the Ministry of Health in Portugal;
- Government science bodies: a dedicated website within CSIC (National Research Council, a network of research institutes similar to CNRS in France or Max Planck in Germany) in Spain and a dedicated website within the Foundation for Science and Technology (science funding agency) in Portugal, in both cases focusing on ongoing research about COVID19;
- Newspapers: El Pais in Spain and Público in Portugal (leading quality newspapers).

The purpose of choosing the two countries was to assess whether there were differences in representation between two neighboring countries with quite different experiences with the pandemic, and the results presented below show that the differences are tenuous.

Collection was carried out using the image search engine of Google (for research with a similar strategy see, for instance, Christidou and Kouvatras, 2013, or Einsiedel et al., 2017) with COVID as the search term, and between November 24 and December 10, 2020, in which the first 100 images from each type of website were identified and coded according to their type (drawing, photo, chart, etc.), content (what is being represented), message (what type of information is attached), and location (section within website or newspaper). The content was first analyzed through a detailed description of the image, which was inductively sorted into three categories: science, medicine, and social aspects (see **Table 1** below). The images from each category were then analyzed through open coding in order to identify the main themes represented (Strauss and Corbin, 2008). This process generated a sample containing 600 images.

This procedure has, of course, multiple limitations. Search algorithms vary results according to the history of previous search activities (even though the history of the browser was deleted), the location of the user, preferred language, and the date of search (most recent images are shown first). The selection

TABLE 1 | Content of images in policy, science, and media websites.

Content	Websites	Policy		Science		Newspaper		Total
		Policy ES	Policy PT	Science ES	Science PT	Newspaper ES	Newspaper PT	
Science	Virus	1	28	23	17	3	20	92
	Lab scenes		2	5	9	5	2	23
	Research objects	2	3	20	13	1	4	43
Medicine	Hospital scenes		4		1	6	10	21
	Health objects		4	8	8	6	9	35
	Infographics	68	16	5	3	9	3	104
	Charts	13	4	13	4	28	9	71
	Maps	5	7	6	2	6	5	31
Social aspects	Street scenes			6		13	10	29
	Indoor scenes		1	1	1	4	4	11
	People	6	14	9	23	6	16	74
	Everyday objects	4	11	3	10	2	5	35
	ICT		6	1	9	12	3	31

of the websites also is limited and other possibilities might have been explored, such as printed editions of the newspapers, other printed materials (leaflets, posters), social media, TV, etc. However, we believe that at a time when digital information was much sought after, institutional websites and online newspapers provide a fairly sound basis for examining what images of science communication the public has been exposed to (though not how the images are being received, understood, or interpreted by the public) and particularly how this scientific issue is being visually portrayed.

RESULTS

The sample containing 600 images was classified by type of website and by the content the images show. The content was aggregated in three main types: science, medicine, and social aspects (Table 1).

Epidemics are an object for public policy (Osborne, 1995). It falls on national governments (and partially on supranational bodies) to take the measures to monitor, control, and eliminate them. In both countries, the government has created dedicated websites that are aimed mostly at journalists and the general public to concentrate relevant information and showcase its actions in dealing with the pressing problem. On the Spanish Ministry of Health website (henceforth will be identified as Policy ES), COVID-19 images are used mainly as illustrations in infographics, in particular about two topics: health-related information (symptoms, prevention measures, what to do in case of infection, existing treatments, and vaccines) and social measures (what to do in case of unemployment, social rights, telework, housing, etc.). The objective is mainly pedagogical and practical: to help citizens make better choices, prevent the spread of the pandemic, and exercise their rights. The same infographic is made available in multiple languages, not just the ones used in the country (Spanish, Catalan, and Basque) but also by foreigners (English, Russian, and

Chinese). The second most common type of content is charts, mainly used in reports, that most frequently represent the number of cases and other scientific data, such as viral load and antibodies.

Conversely, on the Portuguese government websites (henceforth will be identified as Policy PT), the most common type of image is depictions of the severe acute respiratory syndrome-coronavirus-2 (SARS-COV-2) in drawing, most probably from stock images. These depictions are used to illustrate news articles covering a wide range of issues without a clear trend: number of cases, number of outbreaks, what COVID-19 is, immunity tests, confinement measures, etc. The second most common kind of content is representations of people (men and women, of varied age groups), mostly in the form of photos or drawings, also illustrating news articles and retrieved from repositories. The only identifiable person is the Minister for Health, in a news article about strengthening the National Health Service. If anything, the absence of more photos of policymakers on a government website is surprising. A significant number of infographics has also been found, mostly associated with recommendations concerning hygiene (handwashing, food preparation, and shopping), prevention, and respiratory etiquette. Finally, there are also images of everyday objects, mostly food, shopping carts, and tables and chairs; and these are likely to be associated with the priority awarded recently to healthy eating policies by the Ministry, which seem to have extended to COVID-19 recommendations as well.

Regarding the two science websites also purposely created for COVID-19, they are fairly similar in content. Both mostly present information about new research projects being developed in Portugal and Spain in response to the COVID-19 crisis. They are aimed at journalists, the general public (to show how national science has risen to the challenge of fighting the pandemic), and the scientific community itself, to advertise opportunities for funding and collaboration. The images are mostly illustrations accompanying project information, some clearly from stock

images, others directly pertaining to a specific project. In the case of the Spanish CSIC website (henceforth will be identified as Science ES), it also contains reports summarizing international research results (each synthesis of a published article is usually accompanied by an image) and event announcements (each with its poster, pictures of the speakers, and an image connected to the subject of a debate). The Portuguese science website (henceforth will be identified as Science PT) also has calls for project proposals and a news section, always including images. This website is intended to be fed by scientists themselves. They can log on to the website, create a profile with a picture and their research interests, post news about their projects, and upload datasets. Validation of the information is performed by a scientific committee.

For both websites, the most frequent kind of image content is depictions of SARS-COV-2, mostly through a drawing used in a banner of a webpage or as illustration accompanying the description of a research project. On Science ES, the second most common type of content is research objects: lab equipment such as test tubes and Petri dishes, and depictions of cells, DNA helixes, and molecules. In most cases, these are stock images (in particular disembodied gloved hands holding unidentified test tubes). The third most frequent image is charts, all of them included in reports summarizing international research results and therefore retrieved from scientific articles published in journals or pre-prints in repositories.

On Science PT, the most common content found in images is people of different gender and age groups, either in photographs or drawings. Most people in the images are wearing lab coats or protection equipment, and the images are used as an illustration to a research project description. In few cases, people are shown in a non-scientific setting, such as a couple in a kitchen (illustrating a project on healthy eating habits in time of COVID-19) or two children using a hand gel dispenser (illustrating a news article about research projects led by a health research network). In four cases, the persons in the photo are identified: the Minister for Science, Technology and Higher Education visiting research laboratories, in one instance accompanied by the Prime Minister. As in the previous case, research objects are also a common content of the images and are used as illustrations of a research project or a news article: test tubes, microscopes, or a robot.

Finally, newspaper websites, aimed at the general public, tend to show a wider diversity of contents in images. Whereas, the Portuguese newspaper website (henceforth will be identified as Newspaper PT) has created a whole section dedicated to the new coronavirus where the vast majority of images (78) can be found, on the Spanish newspaper website (henceforth will be identified as Newspaper ES) photos are used in multiple sections, but mostly in the lifestyle (15), business (13), and society (13) sections. On Newspaper ES, charts are the leading type of image content and, surprisingly, most are not related to COVID-19 cases but rather to stock value and other economic data. The following most frequent type of content in the images is street scenes, illustrating news articles about the social impacts of the pandemic, not just in Spain but also in Africa and Latin America, and highlighting the international orientation of the newspaper. Finally, images of information and communication technologies

(ICT) (computers, mobile phones) are used to accompany articles about new services put forward by technology companies, such as Google and Twitter, to both provide sound information and restrict false information about the pandemic, and about new apps and games used to contribute to scientific research. Pictures of the virus (in this case, mostly from microscopic photography) are still dominant on Newspaper PT but nearly absent on Newspaper ES. The second most frequent kind of image concerns people, mostly in a photographic format, in articles mentioning risk groups, testing, cases and fatalities, and immunity. There are just two identifiable persons, the head of the Directorate General of Health and a famous footballer infected with COVID-19. The lack of photos of policymakers is, again, surprising, since both in Portugal and Spain, throughout the pandemic, there have been almost daily press conferences with policy representatives who became household names and faces: Fernando Simon, the head of the Director of the Coordination Centre for Health Alerts and Emergencies of the Spanish Ministry of Health and Salvador Illa, Minister for Health of the Spanish government; Graça Freitas, head of the Directorate General of Health and Marta Temido, Minister for Health of the Portuguese government. The third most common type of image represents hospital scenes (usually showing doctors and patients) and is used in news articles about cases and fatalities, hospital capacity, immunity, and outbreaks in hospitals. With the same frequency, photographs of street scenes also illustrate news on cases, fatalities, and outbreaks, and on restrictions to everyday life activities and impacts on the older population.

DISCUSSION

Visualizing the Virus

When a new disease emerges, identifying the cause is a much needed step to diagnose cases and find effective treatments. Hentschell (2014) described how colored lithographs first (which were considered too subjective) and microphotographs later (considered as “the veritable retina of the scientist”) of *Bacillus anthracis* were instrumental for Koch to demonstrate the existence of bacteria as causal agents of disease. As Treichler (1992, p. 75) postulated “a virus is a constructed entity, a representation whose legitimacy is established and legitimized through a whole series of operations and representations, all highly stylized.” Graphic representations of a virus, such as its chemical and molecular schemes, are cultural constructions, a symbolic model of reality.

Viruses were first identified in the nineteenth century, but it took the invention of the electron microscope in the 1930s to be able to visualize them. AIDS started causing fatalities in the late 1960s, but it was not until 1983 that the human immunodeficiency virus (HIV) was discovered. Since then, science has accelerated to the point that SARS-CoV-2 was identified only a couple of weeks (January 12, 2020) after the first cluster of cases of the disease in the Wuhan province of China (in late December, 2019), and its genetic sequencing was published just a few months afterward (Wang et al., 2020).

The first images of the newly discovered virus were produced on the same day that the Coronavirus Study Group of the

International Committee on Taxonomy of Viruses named the virus SARS-CoV-2 and the disease COVID-19 (February 11, 2020). Similar to what happened with AIDS (Treichler, 1992; Feldman, 1995), the disease and the virus are frequently mixed up in non-expert discourses. The first images of the virus were produced using the scanning and transmission electron microscopes of the Rocky Mountain Laboratories of the National Institute of Allergies and Infectious Diseases (NIAID). The virus did not differ much from other types of coronavirus, such as the first SARS-CoV (discovered in 2002), named as such because of its crownlike appearance due to spikes on its surface (NIAID, 2020). Much like how Martin (1994) ascertained for HIV, electron micrographs are presented as scientific “proof” of the virus to produce closure in arguments among scientists. The SARS-CoV-2 images were made available to the public for free and as such are among those retrieved for the sample in this article. However, it should be said that actual photographs of the virus were only found on Newspaper PT. The vast majority of the 98 virus images we found were drawings that smooth out the blurriness of microscopic photography (which in itself is also manipulated by colorization) and draw out the nail-like appearance of the spikes. The colors chosen for the virus are varied but often strong (red, blue, and green). In some cases, the spikes are painted in a contrasting color, often red, and the virus seems to be floating in a background of the same color but of a watered down shade. As Weaving (2020) pointed out, “Images of viruses reveal a monochrome world of gray. Like electrons, atoms, and quarks, viruses exist in a realm where color has no meaning.” The use of color, thus, highlights the menacing nature of the virus, making it look more threatening. Drawings also make it possible to combine the image of the virus with other images, adding another layer of meaning, such as a picture of the virus with a human skull inside (an article about cultural events on Newspaper PT), with a DNA helix (illustration accompanying a research project on Science PT), a microscope (banner for a call for proposals on Science PT), chart lines (a news article on the number of cases on Policy PT), or a stop traffic sign (a poster on what COVID-19 is on Policy PT).

Among the images found on Newspaper PT and Newspaper ES were photos of 3D printed models of the virus, also in vibrant colors, similar to the plush toys manufactured by the Giant Microbes company (Jermy, 2016), which also duly issued a version of SARS-CoV-2 in 2020.

Science as Lab

A crucial dimension of the COVID-19 pandemic is the science around it, and that is clear on the images that are chosen to represent it. A problem that was first seen in the hospital was immediately transferred to the lab, so that it could be “solved.” What started as a virology and clinical health science puzzle rapidly transformed into a multidisciplinary one: immunologists, epidemiologists, mathematicians, pharmacologists, public health experts, mechanical engineers, economists, psychologists, sociologists, and jurists, all became key players to address the multifarious nature of the pandemic. At the time of writing, less than a year before the pandemic started, there are close to 60,000 scientific articles on COVID-19 on the Web of Knowledge and

over 84,000 in the PubMed database. Dedicated funding lines for research projects about COVID-19 were created, both at national (including Portugal and Spain) and supranational levels (e.g., the European Union), for multiple scientific areas.

In contrast with the wide-ranged nature of research, pictorial representations of the pandemic went out the old familiar road of stereotyping science as a sole test tube and lab bench activity. We found 66 depictions of lab scenes or research objects (11% of the sample of images). The vast majority were photographs of laboratories with benches and covered in sophisticated apparatus, and people wearing lab coats (most with their backs turned to the camera, to signify a generic scientist and not some specific practitioner), and of lab equipment (in particular test tubes, Petri dishes, pipettes, and microscopes), often pictured against neutral white backgrounds, being held by disembodied gloved hands, representing the human-non human interaction that underlies the production of science. Lab equipment, thus, serves as a metaphor for science, together with other easily recognizable science signifiers: DNA helixes, cells, molecules, radiographs (which Henschell calls “one of the most impressive visual culture ever created” (2014, p. 281); curiously, only one of these images represents an X-ray of the lungs, the most affected organ by the COVID-19 disease, the others are images of bones). The only concession to the specificity of the pandemic lies in the fact that in some of the lab scenes people are wearing protective gears and face masks. People in lab scenes are both men and women, which is in line with the gender balance of science in Portugal and Spain (close to 50% of scientists and engineers are women), but no ethnic diversity is shown, which mirrors the underrepresentation of minorities in the scientific community. The *mise-en-scène* of lab photos refers the audience to the role of a passive onlooker, in some cases (general panoramic) observing the scene from a distance, in others (close-ups) peeking over the shoulder of a scientist.

Only the Science PT website included some of these images directly related to actual research projects being carried out on the subject and that are not from stock photo archives. That explains why there is also more diversity in the objects being represented, in particular non-lab related equipment (a robot used in hospital settings, new prototypes for ventilators, and 3D printers) and why some of the lab scenes include public figures, such as the Minister for Science, Technology and Higher Education.

In short, the choice of images to illustrate the COVID-19 science tends to reproduce stereotyped notions of scientific research as a laboratory-centered activity, which in turn is replicated in the perception of lay public and in representations (Schummer and Spector, 2007; Christidou and Kouvatas, 2013; Bernard and Dudek-Rózycki, 2017). This follows a long-standing tradition of equating medical science with laboratory research that is questioned even within the field (Warner, 1985).

Representing Private Illness and Public Health

COVID-19 is first and foremost a disease and a health problem. Hospitals are “machines for healing,” the most obvious and

concentrated areas of medical practices (Rose, 1995). Thus, it is unsurprising that over 50 pictures related to hospital settings and medical devices were found. The special characteristic of a contagious and severe illness is reflected in the photographs of hospital scenes: medical doctors, in close proximity to patients in intensive care beds, surrounded by machinery and cables. Other photos show people being tested by medical personnel through nasal swabs, and other ones show people having their temperature measured with infrared thermometers or ambulances parked outside hospital buildings. A common trait of these photos is the heavy protective gear that most doctors and medical personnel are using: personal protective equipment (PPE), several layers of scrubs, gloves, face masks and shields, head coverings, and rubber boots. These sights are more common in other more deadly diseases (see Gerlach, 2019, for the work of the hazardous material (hazmat) suit as a visual signifier of Ebola) or disaster movies such as *Outbreak* or *Contagion* than in traditional hospital images, and reinforce the message that COVID-19 is a dangerous new disease and more stringent protocols and protections are needed. The dominant colors in these photos are white (beds and medical machinery) and blue (hospital scrubs), evoking notions of cleanliness, asepsis, and professionalism. Despite the fact that most carriers of the virus are asymptomatic, that most symptomatic cases are mild and do not require hospitalization, and that even in those cases only a minority requires intensive care, the predominance of these images tends to generate a sense of dread and even panic that may also intend to induce the public to take care and avoid infection.

Some objects are also used as a proxy for representing medicine. Such is the case of photographs and drawings of syringes, vials with blood, pill flasks, and blister packs. These symbolize different stages of medical intervention: testing and diagnosis, treatment, and vaccination. In particular, on the newspaper websites, images of vaccine vials have become more frequent since the announcement of the production of several effective vaccines.

Ventilators are among the most common medical machinery represented, highlighting the technical dimension of medicine (Lawrence, 1990), both in hospital scenes on the newspaper websites and as part of a research project on Science PT. Being placed on a ventilator symbolizes the maximum risk of COVID-19, the final stage of the evolution of the disease, from which two outcomes are possible: death or long-term morbidity (ventilated patients are placed in a coma, sometimes for weeks on end, after which they often have to undergo rehabilitation to relearn how to eat, walk, and perform simple tasks). The number of existing ventilators in hospitals became a point of concern and contention, in particular during the first wave of the pandemic. Lack of equipment led to the need for improvisation and adaptation (e.g., 3D printing of parts and manufacture of low-cost machines—Iyengar et al., 2020).

Due to its contagious nature, COVID-19 is not only an individual illness but also a public health threat. This is particularly evident in the high number of charts we found among the samples images. Charts are a staple of scientific communication among peers and actually started to be used to illustrate basic facts in social sciences in the eighteenth

century (Hentschell, 2014). In this case, bar charts, column charts, line charts, pie charts, and combinations of them appear in news articles, scientific reports, or press briefings. They are mostly used to illustrate the chronology of the pandemic and its tally in terms of tests, cases, and fatalities; but in the case of Newspaper ES, charts are used also to show the impacts of the pandemic, both on economic indicators (prices, stock value, insurance, international trade, and investments) and social ones (unemployment, youth emancipation rate, and opinion polls). In the case of Science ES and Policy ES, we found a wider diversity, including reproduction of charts from scientific publications that address specific issues: forecasts of cases, viral load, antibodies count, antibiotic resistance at the molecular level, genetic profiles, mobility data, survey results, comparisons with other diseases, etc.

Map charts are another common feature in website illustration concerning COVID-19, not in the traditional sense of geographical maps, which show topographic data, but as charts that position data in a geographical context. Whereas, charts often show the evolution of the pandemic over time, maps allow to visualize it in spatial terms, again in relation to cases and fatalities but more often in terms of rates (more comparable) than absolute figures. The global nature of the problem is expressed in the presence of world maps that often show the distribution of cases per country or region or the flows through which the virus spread from its point of origin (China) to all regions of the world, highlighting the risks of an intensively and extensively interconnected world. As members of the European Union and subjected to its political influence and public health issues, the Spanish and Portuguese websites also include maps of Europe. However, much like O'Neil (1990) characterized AIDS as a "global panic" but a "national state epidemic," it falls on national governments to take measures to monitor and quell the disease within its own borders. Thus, the policy websites more often contain maps of the country, with data per region or municipality. That became more frequent in the autumn of 2020, as both countries had moved from nationwide measures (full lockdown) in the first wave of the pandemic to regional or local ones in the second wave of the pandemic: in Spain, the autonomous communities were given more responsibility to define their own restrictions; in Portugal, a risk classification by municipality based on the number of cases per 100,000 inhabitants led to specific measures according to the level of risk (represented in a colored scale of increasing menacing shades of red).

Infographics are combinations of images and texts that provide an overview of a topic. They are increasingly used in science communication and in public health communication, because they are appealing and easy to understand (Lazard and Atkinson, 2015; Polman and Gebre, 2015; Occa and Suggs, 2016; Li et al., 2018). We found infographics that were used for many different purposes in our sample. On the science websites, they are used mainly to illustrate the stages of a research project or its results. On the policy websites, infographics are mostly used to provide simple explanations of scientific information (how the virus is transmitted, which treatments exist, and how vaccines will work) and to issue prescriptions and recommendations:

how to avoid being infected; how to recognize the symptoms; what to do in case of infection; how to maintain hygiene (wash hands, prepare food) and wear a mask; how to act in particular settings (such as schools, workplaces, shops, public transportation, restaurants, beaches, and pools); how to provide psychological support to elderly people, children, and teenagers; and how to claim social provisions (in case of unemployment, layoff, telework, or eviction). Accordingly, these infographics mainly rely on drawings (icons) of people, body parts (face, hands), objects, or actions, at times connected by arrows to illustrate processes. Although always accompanied by textual information (in several languages in the case of Policy ES), some are meant to be understood even by illiterate audiences. Hygiene discourses stem from moralizing campaigns, previous to the discovery of microorganisms, which attributed illness to uncleanness (Martin, 1994; Lupton, 2012). Hygiene campaigns supported by visual aids, such as posters and postcards, are an often studied topic in the social analysis of epidemics, such as syphilis or AIDS (Cooter and Stein, 2010; Bastos, 2011; Hamilton, 2019). This tool of public health exhorts individuals to take responsibility for their own bodies to maintain health and prevent disease (Lupton, 2012). Yet, the sociology of health and illness shows that “there is no direct relationship between an individual’s level of knowledge of and attitudes toward a disease and behavior. Information alone is therefore insufficient to promote meaningful changes in risk behavior” (Pollak, 1992, p. 32). The same author explained that the most effective messages need to contain explicit information about the severity of a disease, individual susceptibility, how likely the change in behaviors will lower the probability of becoming ill, and how the benefits of changing behaviors are higher than the costs.

On newspaper websites, infographics are mostly used to convey information from scientific research in a clear and understandable way. Of particular note is the two animated infographics published by Newspaper ES on “An analysis of three Covid-19 outbreaks: how they happened and how they can be avoided” (18.06.2020) and on “Aerosol transmission of Covid-19—A room, a bar, and a classroom: how the coronavirus is spread through the air” (29.10.2020), that were widely shared and commented on. The latter was read by over 12 million people and republished in English, French, and Portuguese. This infographic was prepared by a dedicated team in the newspaper, responsible for “Visual Narratives” and inspired by an article written by a researcher in the same paper a few months back (Equipo de Comunicación, 2020).

Social Aspects of a Pandemic

COVID-19 is far from being only a scientific or medical issue. As in any pandemic, the social conditions that turn an individual illness into a public health problem (transmission) and the social impacts of a disease whose control requires restrictions to everyday life are another dimensions that are also expressed through visual means.

Photographs of empty streets, closed down shops, people wearing surgical masks on a subway, in a street market, or in a classroom (also a regular sight in photographs of the 1918 influenza pandemic), and of people sitting inside plastic

bubbles in a pavement café are a common feature on the two newspaper websites, and are used to illustrate news articles about government measures and statistics on the number of cases and fatalities. Conversely, there can also be found photos with a diametrically opposite content: large gatherings of people without masks in public parks or in street demonstrations. These photos accompany news articles about countries that eschewed lockdowns or where demonstrations against restrictive policy measures took place. On Newspaper ES, it is curious to note the geographical diversity of these photos, showing scenes not just in Europe but also Africa and Asia, a symbol of the global nature of the pandemic (and also the international reach of the newspaper).

On Science ES, photos of street scenes are used to exemplify research projects of a sociological nature and an online debate between scientists on the social impacts of the pandemic.

Images of common people (as in not identifiable as scientists or medical personnel), both photographs and drawings, are mostly used to illustrate the social impacts of the pandemic and risk groups (in particular older people and pregnant women). They tend to show gender and age diversity but not ethnic diversity. Despite sizable communities of non-European descent in both countries, they are mostly underrepresented or invisible, erased from the public space and “from representations of the banal country” (Carvalho, 2006, p. 87; see also Ferin et al., 2008; Marcos Ramos et al., 2020). The social impacts most often illustrated by these pictures are the growth rate of unemployment, decrease in tourism (particularly worrying in two countries whose economies strongly rely on this sector), restrictions to consumption (non-essential shops, restaurants, and leisure businesses forced to close down), and impacts over education (school closures affecting learning outcomes).

Everyday objects, such as foods, kitchen utensils, shopping carts, and bottles of detergents, are usually shown in isolation (iconic value) and are used to represent research projects on the science websites and prevention recommendations on the policy websites, which remain particularly focused on hygiene (washing hands, disinfecting surfaces, and decontaminating food) rather than protection against aerosol transmission.

ICT objects are here in a class of their own. Photos or drawings of mobile phones and computers, either by itself or in the act of being used by human actors, are present in all types of websites. They show how digital technologies play an unprecedented role in this pandemic. They are shown in images representing apps to trace contagions, the widespread move to telework, fake news circulating in social media and the efforts to curb them, the growth of online shopping, phone psychological support, or the COVID-19 global trackers provided by diverse scientific (WHO, Johns Hopkins University) and media institutions (BBC, CNN). They illustrate how ICT objects have become fundamental tools to collect and share information about the disease, perform scientific research, provide services to consumers, and allow many dimensions of every day to continue functioning, albeit in a virtualized mode. Their downsides, for example, in terms of the rapid spread of misinformation and disinformation, often about scientific issues, also became more acute and an issue for political concern.

FINAL REMARKS

In short, pandemics are social, health, scientific, medical, and political issues, and their diverse nature is reflected in the way they are visually communicated with different media. The analysis of the visual content of the three types of websites from Portugal and Spain allowed us to explore the multiple forms of representations of a pandemic. The differences between the two countries are slight, with some exceptions, such as the predominance of images of the virus on the Portuguese websites, of economic charts on the Spanish newspaper website, or few more images of politicians on the Portuguese websites.

We have found that, as in previous pandemics, the visual representation of the virus, with its distinctive spikes, available at a much earlier stage than usual, became a convenient shorthand to identify all website contents pertaining to the pandemic. Stylized drawings or blurry electron microscope photographs signal that what the audiences are about to read concerns COVID-19 as a disease, research topic, object for policy intervention, or cause for social impacts.

The scientific dimension of the pandemic is still very much represented by people in white coats and goggles, laboratory benches or microscopes, and DNA helixes. Despite the strenuous work of epidemiologists, mathematicians, biostatisticians, engineers, economists, and sociologists, they still do not get their own symbols and identifiers. However, the data they produce do appear, under the guise of charts, maps, and other illustrations of scientific results.

The medical side of COVID-19 is present in frightening pictures of intensive care units, doctors in hazmat suits, and unconscious patients in ventilators. A further cause for panic is the visual impact of statistics of ever-growing curves and ever-expanding blots on maps.

Some graphic representations are explicitly intended to induce change in behavior through prescriptive illustrations of protection measures in different settings or, if that fails, of what to do in case of contagion.

The social aspects of the pandemic are mostly represented by striking images of the impacts of the lockdown measures (eerily empty streets, closed shutters in shop fronts, and commuters in

surgical masks), and of prevention measures particularly focused on hygiene (washing hands and disinfecting shopping carts) and healthy eating. It is unprecedented what central digital technologies have become and how often they are present in illustrations of the pandemic.

So, what is new about the visual representation of the COVID-19 pandemic? Not everything, since there are many throwbacks to previous pandemics (AIDS, the 1918 influenza, even Ebola) and to stereotyped ways of showing science. It is unprecedented how fast science was able to produce photographs of a new virus invisible to the naked eye, how widespread graphic representations of data concerning the spread of the pandemic became, and how exceptional the images of once bustling and now empty cities. Just as invisible as the virus are the ways in which it is transmitted. Infographics attempt to make this invisibility visible, providing useful advice to concerned citizens.

What we have tried to show is that there is more than a way to represent a pandemic, but not all of them can be covered by the analysis we have performed. At a time when moving images are so dominant, to focus on still images from websites is undoubtedly reductive. Though this is a young pandemic, a diachronic examination of the year of images would have yielded more information on changes over time; and by focusing on what is shown, we seldom reflected on what is omitted from the visual representation of the pandemic.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

AD conceived the presented idea, carried out literature revision, collected the data, and drafted the first version of the manuscript. JR contributed to the design and implementation of the research, analysis of the results, and writing of the manuscript. Both authors contributed to the article and approved the submitted version.

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Communicating Corrected Risk Assessments and Uncertainty About COVID-19 in the Post-truth Era

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The COVID-19 pandemic has been a challenge for science communication in terms of addressing the question of uncertainty and how it translates into risk. This task has been aggravated by the complexity of the pandemic and the current post-truth environment. The article suggests that there is a need to analyze the practices of correcting risk information that is uncertain, but not necessarily false, made by online news media about COVID-19. This is a point of analysis where the uncertainty and risk linked to science, the pandemic, and the post-truth condition meet. The qualitative discursive analysis yielded three important results: (1) uncertainty can be fought by increasing uncertainty; (2) a multiplication of facts or reasons may not be the most prominent strategy in practices of correction; and (3) the use of hyperlinks with additional information can increase uncertainty and risk.

Keywords: COVID-19, science communication, risk, uncertainty, discourse analysis, actor-network-theory, post-truth

INTRODUCTION

COVID-19 has not only been characterized as a viral infection but also as an “infodemic” issue that has permeated the functioning of science communication with an abundance of information and misinformation (Pulido et al., 2020; Graham, 2021; Hope, 2021)¹. Science communication is a theoretical and practical field in which questions of public health (Chen et al., 2020; Head et al., 2020) are intertwined with issues of uncertainty (Paek and Hove, 2020; Atherton, 2021; Grace and Tham, 2021) and risk during this pandemic (Chou and Budenz, 2020; Lovari, 2020; Batova, 2021). The questions of uncertainty and risk have, moreover, been aggravated by the socioeconomic complexity of the pandemic (Guan et al., 2020; van Barneveld et al., 2020). The complexity of the COVID-19 crisis has also been associated with the era of “post-truth,” which had already complicated the relationship between science and society before the start of the pandemic and persists in the present moment (Meese et al., 2020; Patel et al., 2020; Koerber, 2021).

The science communication on COVID-19 is characterized by “uncertainty-risk” because the knowledge it discusses is open to falsifiability, meaning there is a risk of the information being disproven (Popper, 2002). However, such scientific uncertainty becomes more difficult to communicate due to the high risk of mortality and morbidity during a pandemic (Zhai et al., 2020). On the one hand, scientific uncertainty becomes more evident because it not only involves scientific reasoning but also political reasons and decisions that are beyond scientific evaluation, which increases the risk of unforeseen impacts (Guttman and Lev, 2020; Lasser et al., 2020). On

¹The author wants to thank all the insightful suggestions of the Editor, Anabela Carvalho, and those of the two anonymous reviewers. The author is the only responsible for the weaknesses of the article.

the other hand, during a pandemic, the communication of uncertainty has an impact on the management of risks because these can be aggravated or ameliorated by public behavior. The public is the object and means of contamination, and behavior of the public can change according to the information available about the virus (Post, 2016; Hendriks and Jucks, 2020; Hendriks et al., 2020). Thus, the article explores that the risks of the pandemic increase the uncertainty of science and its communication. In turn, the uncertainty of science and its communication aggravate the risks of the pandemic. The COVID-19 crisis has a communicational dimension, given that information about the pandemic is used in the public sphere as a way to deal with it. The communication of uncertainty at a time when people can die and lose their health correlates with risk because to be unsure about a thing that kills people creates the conditions that endanger life.

The situation of post-truth, which existed before the pandemic started and had already threatened the communication of scientific uncertainty, increases the communicational complexity of the present crisis because the authority of science is publicly challenged. Academic research about post-truth has been concerned with at least two versions of the phenomenon. Version 1: post-truth is understood as a form of deception that is usually associated with politicians who strategically distort knowledge to achieve certain power objectives (Waisbord, 2018). This manipulation is targeted at certain vulnerable public groups that are considered to be delusional, dogmatic, and ignorant (Bronstein et al., 2019). Version 2: post-truth is also understood as a period during which different epistemic projects that have been overlooked by science are reclaimed (Fuller, 2018). This opportunity arises once the notion that scientific knowledge can solve, with certainty, all political problems is questioned. Among those who feel neglected by science, it can be included people who demand a form of science that establishes a dialog with society and includes diverse types of knowledge to inform political decisions (Jasanoff and Simmet, 2017; Palliser and Dodson, 2019; Manyweathers et al., 2020). Such a dialog, among other things, demands the recognition of consequences related to the links that science has established with technological markets (Cooper, 2008) and military investments (Mukerji, 2014). More importantly, this second post-truth version recognizes that science is engaged in “power–knowledge relations” (Foucault, 1979). According to the Foucauldian thesis, science creates opportunities for the government to be more efficacious in its exercise of power by learning how to exercise it with less resistance. This exercise of power constitutes, in turn, a phenomenon that can itself be studied to improve that same dynamic. This point of view means that power does not only operate through violence, brutality, ideology, or deception but also through knowledge and being truthful, and using the best knowledge available. In version 2, the uncertainty is not destructive of science due to political motives but constitutes a moment to question the political implications that are associated with that uncertainty. If the certain knowledge constitutes an opportunity to exercise power intelligently, then uncertain knowledge is open to uncertain political effects, which can be dangerous. This means that the communication of science, which

refers to the creation of public trust in scientific content that has a social impact (e.g., the reputation of scientific institutions, social attitudes toward science, public investment in science, and how the public should behave during a pandemic), already raises political issues. The communication of science thus constitutes an opportunity that can increase or decrease the power of scientific institutions over public matters.

One important moment of encounter between the challenges of uncertainty and risk can be found in the news media practice of “correcting” information about COVID-19. Corrections are needed not just because the scientific evidence has been proven wrong or false, but because the COVID-19 pandemic is complex in communicational terms. During the COVID-19 crisis, science communication, risk communication, health communication, and political communication come together to produce a challenging mix (Guttman and Lev, 2020; Lasser et al., 2020). Another important reason for continued media efforts to correct information is that the scientific and biomedical evidence about COVID-19 is changing rapidly and constantly. As a result, scientific and biomedical institutions around the globe are concentrating on the production of knowledge about the novel virus (Zhai et al., 2020). The literature about the correction of scientific messages in the news shows that there is growing research focus on the topic of “fact-checking” (Graves, 2018; Amazeen, 2020). There is also relevant work about “apologies” in the media (Kampf, 2011; Opt, 2013; Ancarno, 2015), and there is a special focus on social media as a digital space for the correction of scientific information (Vraga and Bode, 2017; Smith and Seitz, 2019; Van Heekeren, 2020). However, there are few studies about the correction of scientific information in the news when what is in question is not to prove if a fact is true or false, or to present apologies for some wrong-doing, or to use social media strategies to fight misinformation. Our interest is rather in the reporting of the constant change in scientific evidence in the media, as is the case during this pandemic. The few existent studies on this topic are about the “swine flu” or the H1N1 influenza pandemic of 2009, and they claim that there was a lot of conflicting information (Klemm et al., 2016). The strategies to correct this information were motivated by a reductive journalistic framing of the complex risks of a pandemic (Chan, 2016). However, these studies do not focus on a detailed analysis of the corrected information. The research about media exposure of scientific retractions is the topic that is closer to the question of correcting of scientific information in the news (Sarathchandra and McCright, 2017). The information that is corrected in the media about COVID-19 is, however, not the result of a “retraction” of scientific results. In the COVID-19 crisis, media are rather dealing with the emergence of new scientific evidence or new policy recommendations based on new evidence that makes previous results and policies outdated but not necessarily false.

The current gap about the correction of information in the media in the literature of communication studies, and especially in science communication, should be addressed because at this particular moment it has maximal relevancy. Especially now, science has to correct itself by creating a space where it can be publicly contested or praised for its capacity to correct

itself. Science communication has to be able to deal with past information that is considered risky in the present and needs to be revisited, without raising or downplaying the risks that a pandemic situation brings. Given the complex character of the pandemic, the speed of the news, the constant production of scientific results, and the “post-truth” condition, it is necessary to analyze how the news media engage in corrective practices of information (Fu and Zhu, 2020; Krause et al., 2020). In other words, it is time for science communication of corrected risk (SCCR).

The concept of risk that informs this analysis is that of the sociologist Ulrich Beck. This author tells us that science and technology not only manage to control “natural” risks but also produce their own risks by incrementing technoscientific complexity and uncertainty in the world. The concept of risk of Beck is defined by a kind of an autogenetic and irreducible production of risk (Beck, 1992). Brian Wynne is another important author for the conceptualization of risk because he made a kind of “conceptual transfer” of the concept of risk of Beck into science communication (Wynne, 1998, 2002). Wynne suggests that when experts hide risks from the public and do not take into consideration the risk evaluation of non-experts about a dangerous situation, they raise the level of risk caused by the original situation. This scenario occurs because experts do not engage in open and dialogic communication during which additional knowledge about risks could be shared and debated from different perspectives (Wynne, 1992). Risk is, then, produced and negotiated during interactions. Taking these two considerations from sociology and science communication as a starting point, what I want to study is the level of risk that is produced by the communication of science. This is a “communicational risk” in the sense that science communication is an attempt to fight risks and, as a technique, it can produce other risks. These risks could be, for example, misunderstanding, an increase in uncertainty due to competing information, communicational self-fulfilling prophecies, and the legitimization of dubious political effects by scientific authorities. Communication is engaged in an irreducible production of risk, which means that I follow the contribution of Beck. This perspective also means that it is necessary to be attentive to the new risks that the correction of risk produce and to be moderately skeptical about any claim about the absence of risk. I also want to study, following Wynne, how the media try to incorporate different risks that are communicated by at least two parties: the corrected and the correcting one (this process can also apply to one actor correcting in the present its past affirmations of risk). I hope to find a discursive interaction about risk and how that interaction affects the degree of risk communication. Both understandings of risk, as irreducible and interactive, make the communication of uncertainty in COVID-19 a paradoxical mission, and thus it is this paradox that is investigated. We need to recognize that to communicate risk is always a communication of a risk that is irreducible. We cannot know everything that makes our behavior risky, but we can know that uncertainty is certain.

Given that risk is irreducible and can be augmented through the efforts of communication that try to manage it, this means

that the SCCR will be a question of achieving equilibrium. The research problem that guides the article will be the following: How can we communicate a corrected risk associated with scientific topics without communicating an absence of risk or a certainty of risk? The absence of risk is impossible, given the argument of Beck, and the certainty regarding risk refutes the proper character of risk defined as a “certain incertitude.” In other words, *how do we correct risk in science communication with an acceptable level of risk?* Put differently, how can we correct scientific information without associating the subsequent corrected communication with an absence of risk or an absolutization of the certainty of risk? The communication of information free from risk or presenting the inevitability of risk would defeat the very idea of risk, which is defined as a “certain incertitude.” How do we deal in science communication with a form of uncertainty that cannot disappear completely without consequences for the open character of science and the overlooking of risks that stem from that openness, especially during a pandemic?

The SCCR can make a useful difference through its management of uncertainty. SCCR needs to analyze the uncertainty associated with the open, debatable, and falsifiable character of science, and how it relates to risks associated with that uncertainty. The moment of the correction of risk touches the heart of science understood as a process of debate and confrontation (Kuhn, 1970) to reach a temporary consensus that is always open to falsification (Popper, 2002). In this sense, by being an act of communication about a debatable and falsifiable science, science communication cannot but deal with that openness and uncertainty. As the philosopher of science, Stengers (2000) argues, to do a scientific experiment is to put oneself at “risk,” to be open to failure, to face the uncertainty of success. However, it is this space of risk provided by the experiment that can prove something that is not entirely made up by the subject (an artifact) because it is also made by the experiment (a fact). During a pandemic, experimental “scientific risk” combines with socioeconomic risks and with risks that stem from post-truth. These double epistemic and political effects make scientific risk one of the most relevant topics in the correction of uncertainty for science communication. The communication and correction of uncertainty during a pandemic are about more than just transmitting scientific information. This process is a way of contributing to the political management of a public health crisis in individual and collective terms.

According to the second version of post-truth, the correction of risk will also be an opportunity to see how it opens up a space of debate concerning the political implications of the science that need to be rearticulated. Science communication is an example of a power-knowledge relation in action. The moment that a risk is corrected destabilizes the relations of power that were associated with a certain level of risk. This correction constitutes a singular moment to study the second version of post-truth, since the possibility to debate the new political significance of a risk is changing. It can, however, be made clearer how the post-truth condition of science communication, as a field that is always tied to certain power effects, relates to the lingering possibility of risk. Science has to be communicated in a way that preserves

the possibility that it can be disproven in the future, that is, it is communicated with an irreducible level of uncertainty. It is, moreover, equally impossible to totally eliminate risk. Hence, the communication of an uncertainty–risk relation produces the power of telling who is at risk, who can escape that risk, what people should do to avoid risk, and what the consequences are of risk-taking. This power operates through the order of discourse that structures the pandemic world in terms of what modes of living are acceptable concerning different risks for different lives.

MATERIALS AND METHODS

The above-stated problem will be addressed through qualitative methods. This study utilizes three tools from *Science and Technology Studies* (STS): Semiotics of Science (Latour and Bastide, 1986), Rhetoric of Science (Bazerman, 1988), and Actor–Network Theory (ANT) (Latour, 1996). These tools have already been used in Science Communication studies and have been associated with interesting results. Examples come from Lowrey and Venkatesan (2008) (semiotics), Myers (2003) (rhetoric), and Davies (2019) (ANT). Here, the original contribution will be the application of these qualitative methods to the SCCR. These three approaches are the conceptual tool boxes to analyze news media correction strategies of COVID-19 information.

The so-called linguistic turn (Rorty, 1992) in the academic world made the language more “thick” and less transparent by questioning the notion that a “neutral” medium exists to convey formless and non-linguistic independent content. As a result of this concern with the role of language as a medium that shapes the world, the linguistic production of certainty became important for those studying communication (e.g., Wittgenstein, 1991). In simple terms, we can say that to convey certainty to a message, we have to use language that is appropriate to that end, and the same thing holds for the production of uncertainty. Both are linguistic products, both of them need a certain syntax (order), semantics (meaning), and pragmatics (context) to exist. One important linguistic device that gives degrees of certainty to a message is “modality” (Latour and Woolgar, 1986, p. 77). A modal word is a linguistic element that can attribute more or less certainty to another word about what is claimed. For instance, there are degrees of certainty that can be translated as suggestion, possibility, or necessity: “we *suggest* that something will happen”; “it is *possible* that something happens”; and “it is *necessary* that something happens.” The degree of certainty that something will happen in these three sentences changes with the use of these modalizers. Latour and Woolgar (1986, p. 77–80) tried to show semiotically that scientific sentences can be characterized as more or less factual through the type and number of modalizers used. A scientific fact would be, linguistically, a claim in which there are strong modalizers (e.g., “necessity”). If a fact is written with weak modalizers (e.g., possibility), it has a less factual character. One important insight from this semiotic approach is that a scientific fact with a strong modality equals a fact from a “scientific textbook.” The scientific claim has become something that is considered as a given and can be taught in schools without much controversy (Latour and Woolgar, 1986, p. 76–77). This insight also means that cutting-edge science uses modalities that are not

too strong. However, this type of science is the most relevant because it ventures into new knowledge in a highly competitive scientific system and is ready to destroy any strong modality. The semiotics of science, thus, shows that the strongest science is produced with uncertainty, with weak modalities. Thus, risk can discursively be studied as a case in point of modality. The study considers the contribution of Beck, who conceptualizes risk as something irreducible, that is, something that “*can always*” happen, characterized by a “*possibility*” of which the probability is “*never*” zero. Given that during a pandemic there is an “uncertainty–risk” relation, the semiotics of science is useful to treat uncertainty and risk as cases of modality because they never disappear completely and need to be discursively modalized. This state of affairs is especially true during a pandemic because scientific knowledge is constantly changing in response to the risks of the pandemic whose effects feed back into science.

To enrich the approach to semiotic modality, I will also analyze it from the perspective of the Rhetoric of Science. This field of study attempts to show that the communication of science between scientific peers is already a rhetorical achievement. The roles of *ethos* (the credibility of the author), *logos* (the reasons used), and *pathos* (the audience that analyzes author credibility and the reasons used)²—the three elements of Aristoteles’s *Rhetoric* (Aristotle, 1984)—are crucial for any successful production of scientific knowledge (Bazerman, 1988). Latour and Woolgar (1986, p. 201) show this rhetorical dimension when they claim that science can be understood through “cycles of credit,” where the credibility of scientists, institutions, scientific methods, and instruments mutually reinforce a “scientific capital.” For instance, they noted that scientists in a lab simultaneously used different forms of credibility: “When I consider all the investment I made in this *substance* in the laboratory and I don’t even have a *good assay* for it: If *Ray* is *unable* to set up this assay, he will be fired” (Latour and Woolgar, 1986, p. 199, my italics). The credibility of the substance is associated with the credibility of the assay, and the credibility of the assay is associated with the credibility of Ray. Rhetorically, the communication of science between peers already mobilizes *ethos*, *logos*, and *pathos* dimensions of discourse. The risk or uncertainty associated with scientific topics has effects beyond the scientific realm when the “confidence” or “reliability” of the results has to be translated into credibility in science by society. To communicate risk is to communicate more than scientific or epistemic risk (e.g., the risk of being wrong); it is also a political and social risk that stems from scientific uncertainty. SCCR, therefore, cannot just be “science” communication that is solely focused on the transmission of facts about COVID-19. In that sense, SCCR is directed at the publics outside the scientific realm and cannot escape from engaging with the rhetorical moves of *ethos*, *logos*, and *pathos*. Credibility, logic, and audiences are extremely

²This research follows the definition of *pathos* of the rhetorician, Meyer (2010, p. 407–408). *Pathos* means not just an audience who is persuaded through emotions or passions, but also the audience who must be persuaded with reasons from a credible source. Otherwise, the credibility and the reasons would not have any relevant persuasive function if the audience were just convinced with emotional appeals.

important for the successful public communication of science (Fahnestock, 2020). For instance, the phrase “flatten the curve,” meaning the reduction of the statistical count of infections and death by COVID-19, has been used as “a rhetorical anchor for communicating the risk of viral spread” (Amidon et al., 2021). Other rhetorical studies suggested that the elements of *ethos* and *pathos* have a prominent function when the science that is being communicated is associated with risk (Miller, 2003; Simon, 2020) or public contestation (Martini, 2018).

Finally, the article complements the semiotic and rhetorical analyses of modalization with the method of actor–network theory (ANT) in order to understand how modality materializes. Modality can be strengthened or weakened by material networks that can consist of, for example, human, textual, biological, architectural, or institutional elements. ANT is a social theory that tries to understand “whether or not a connection is established between two elements” (Latour, 1996, p. 372). These connections, networks, or linkages are made by “actors,” defined broadly by ANT as “something that acts or to which activity is granted by others” (p. 373). ANT follows the lessons of ethnomethodology in the sense that the analyst has to follow the actors and concretely see their movements in order to understand how they interdefine each other and themselves (Latour, 1999, p. 19). ANT is a method that encourages us to search “a continuity, a multiplicity of plugs” between different types of actors—textual actors, social actors, or natural actors (Latour, 1996, p. 377–378). For instance, society can be defined in opposition to the natural (e.g., a building is not a tree) or in association with the textual (e.g., the Constitution gives social rights). What is important is that the analyst has to follow how these concepts interdefine each other, instead of presupposing that one of the actors is dictating unilaterally what the other is. However, Latour claims that these categories of the social, natural, scientific, and textual are “arbitrary cutting points on a continuous tracing of action” because the objective of ANT is to understand how these categories are made through a “network,” a relational work, to “attribute ‘textuality’ or ‘sociality’ or ‘naturalness’ to this or that actor” (Latour, 1996, p. 378–379).

The “second version” of post-truth, with its Foucauldian overtones, has a discursive–analytical counterpart. The study followed the invitation of Angermüller (2018), who claims that Discourse Studies should embrace the second version of post-truth. This invitation confirms the already politically oriented character of critical discourse analysis (CDA) that reclaims the heritage of Foucault (Wodak and Meyer, 2009). His discursive–power approach is laid out in *Orders of Discourse*, and he introduces the concept of power analytics in *Discipline and Punish* and in the first volume of the *History of Sexuality*. Foucault argues in his articulation of discourse and power, which will be highly influential for CDA, that discourse is a way of ordering experience and establishes who is allowed to talk, where, and when (Foucault, 1971). Additionally, Foucault reminds us that discourse is not an expression of a discursive reality of power and knowledge relations. It is only in discourse that those relations can be articulated, which means that power does not only operate by silencing discourse or deception. If discourse is where knowledge and power are articulated, this means that

power can also operate by making people speak. This results in incentivizing them to talk about themselves and to share their identities and secrets in order to know them better and to control them more efficiently and with less resistance (Foucault, 1978). Foucault shows that discourse is neither something that power–knowledge relations use after they are formed, nor that power silences the sound of knowledge. It is in discourse that power and knowledge operate, exist, and produce effects. We can also see that Foucault gives us a discursive thesis that is adequate for analyzing the second version of post-truth because it is through truth and knowledge that power and political effects happen, and not just through deception or silencing science.

It should be noted that, in terms of the discursive power of modality, there is an important research tradition in communication studies that are already trying to understand how this linguistic function produces relations of power. CDA profusely uses the linguistic analytics of modality proposed by the linguistics scholar Michael Halliday. The work of Halliday enters CDA through the Critical Linguistics (CL) of Hodge and Kress that resulted in contemporary CDA (Wodak and Meyer, 2009). CDA is characterized by the inclusion of other political theories besides the Marxism of CL, namely a Foucauldian analytics of power. Although the larger field of communication studies, which includes media studies or risk communication, has studied modality, the modality has not received systematic attention in the specialized field of the public communication of scientific topics with risk impacts. There is valuable work in discourse studies about Science Communication, including science associated with risk (Tollefson, 2014; Maesele, 2015). There are research studies in the field of science communication that uses discursive approaches, including studies that focus on the question of modality (Stamou et al., 2009; Simmerling and Janich, 2016). However, there is a lack of discursive approaches to the public communication of scientific topics subjected to the *correction* of risk information that uses *modality* as an analytical tool. The research that uses modality to study the public communication of scientific matters, which is not about risk correction, claims that weak modality is used to reduce the certainty of what is being communicated (Motta-Roth and dos Santos Lovato, 2011; Szymanski, 2016). The power implications of such a move, however, have not been further explored. The power effects of modality are only taken into account when a strong modality (e.g., certainty) is used illegitimately to impose a scientific vision as unquestionable (Stamou et al., 2009; Heffernan et al., 2011; Nhung, 2018), which is closer to the first version of post-truth.

However, the modality of scientific discourse in the public sphere has a nuanced power function that asks for a specific discursive approach. Instead of following the linguistic research program of Halliday, the semiotics of science follows the French semiotic tradition of Algirdas Greimas (Latour, 1996), which is combined with the Foucauldian thesis of power–knowledge relations (Latour and Woolgar, 1986, p. 229). This incorporation turns the study of modality into a powerful instrument to analyze scientific discourse. According to Latour and Woolgar, the institutional credibility and monetary credit stem from the credibility that science produces with its discursive modalizers,

which depend on the credibility of the instruments and the researchers, which in turn needs institutional and monetary credit to exist (Latour and Woolgar, 1986, p. 201). For example, a strong modality in a scientific statement can be necessary to obtain a grant but can reduce the credibility of the researcher among their peers. Experiments of cutting-edge science do not warrant strong modalities and, without peer legitimacy, funders will not trust strong modalities. So why use the semiotics of science instead of the CDA approach to modality? First, the semiotics of science of Latour and Woolgar already incorporates a power dimension by relating the modality of scientific statements with institutional power and money. Second, the question of modality in scientific topics is different from the themes traditionally studied by CDA (ideology, media, gender, race, etc.). The scientific discourse asks for a modalization that encapsulates a specific risk that has a double character: (1) the risk of being falsified, and (2) the risk of not being able to be falsified (which is an essential element of scientificity). In CDA research and other discursive approaches to science communication, the study of modality concerns cases in which the modality is made stronger (necessity of something or certainty) to hide the subtle and complex meaning of a reality that is usually composed of possibilities and probabilities rather than inevitabilities. This kind of strong modalization is explained by the need to obtain power through that simplified reality (Stamou et al., 2009; Nhung, 2018). Contrary to CDA approaches, the semiotics of science is concerned with the subtle power of modalization that works through weak modalities. In the public communication of scientific knowledge associated with risks, we are not only confronted with the problem of strong modality, but also with the power of weak modality. Weak modality not only is used as a way to protect science from becoming dogmatic and antiscientific, but it also carries the risk of appearing publicly weak in its epistemic assertions. This weakness is, however, necessary when there is a risk involved, that is when there is a certain uncertainty of danger.

The data consist of three news articles: a piece from the BBC about new advice from the World Health Organization (WHO) on the general need to use a mask although previously this was deemed unnecessary (Triggle, 2020); an online news piece from Euronews that tried to counteract previous news about the protective role of tobacco in COVID-19 infections (Holroyd, 2020); and finally a news piece from *TIME* magazine that corrected the claim of Maria Van Kerkhove, a technical leader at WHO that the asymptomatic transmission of COVID-19 was rare (Ducharme, 2020). What these three pieces have in common is that they do not constitute corrections of wrong information but correct the incertitude of scientific information that is associated with risk. Instead of attempting to say that something in the past was wrong, these pieces are trying to shift the role of uncertainty to manage the risk communicated. In other words, the corrected information is not more certain but is believed to be less risky. The choice of these three documents is based on three methodological principles derived from CDA (Wodak and Meyer, 2009) that define what makes a text relevant to be analyzed in terms of society–discourse relations: (1) they are public and widely spread discourses, which makes them relevant for the study of the relations between society and discourse; (2)

they are produced by powerful media institutions that play an important role in framing and determining the agenda-setting of topics in the public sphere; and (3) they represent different geographies of news media production and thus assure plurality in the analysis. The selected articles are accessible online, which increases their impact in terms of the number of readers they reach; they come from three news media institutions with long-standing credibility; they represent three different geographies of news media production (The United Kingdom, Europe, and The United States of America). In terms of their adequacy for the approach to the problem of the SCCR, they present three examples of important moments of communication during the pandemic that were the object of the correction of information: the use of masks, the infection risk of smokers, and the risk of virus transmissibility.

RESULTS AND DISCUSSION

Semiotic Modality in the BBC News Piece

Modality can be a useful tool to investigate the discourse of SCCR. Instead of communicating that something is (certainly) true or (certainly) false, risk communication works in a field where a lack of certainty forces us to approach falsehood and truthfulness as relative degrees. The study of modality offers one of the ways to approach how those degrees are managed in the communication of topics that involve risk. Considering the previously stated problem, modality can be helpful for understanding how science communication uses modality to correct risk. The first question that stems from the problem is: *How does SCCR modalize corrected discourse?*

The BBC news article from June 6th of 2020 has a dimension of newsworthiness that is linked to a change in the position of WHO regarding the use of mask. In the following extract, the underline text represents the semiotic moves used to mark that change, and the bolded words indicate when a modality is used to produce a variation in the degree of certitude about risk:

Coronavirus: WHO **advises** to wear masks in public areas
 The World Health Organization (WHO) has changed its **advice** on face masks, saying they **should** be worn in public where social distancing is **not possible** to **help stop** the spread of coronavirus. The global body said new information showed they **could** provide “a barrier for **potentially** infectious droplets.” Some countries already **recommend** or **mandate** face coverings in public. The WHO had previously argued there was **not enough** evidence to say that healthy people **should** wear masks. However, WHO director-general Dr. Tedros Adhanom Ghebreyesus said on Friday that “in light of **evolving** evidence, the WHO **advises** that governments **should encourage** the general public to wear masks where there is widespread transmission and physical distancing is difficult, such as on public transport, in shops or in other confined or crowded environments.” (...) The organization had **always advised** that medical face masks **should** be worn by people who are sick and by those caring for them. The organization said its new guidance had been prompted by studies over recent weeks. (...). At the same time, the WHO

stressed that face masks were **just one** of a range of tools that could be used to **reduce** the risk of transmission—and that they **should** not give people a **false sense** of protection. “Masks on their own **will not** protect you from Covid-19,” Dr. Tedros said.

One important quantitative result of the analysis of this article is the high number of modalizers, or words that play a semiotic role in modalizing the certitude of statements, in comparison to the small number of words that signal a change in risk communication. This result will be a common trait in all the three analyzed articles. The change of the position of the WHO is justified by new scientific evidence that was not available in the past. Interestingly, this new evidence is also presented in modalized terms: the infectious droplets are “potentially” infectious (not absolutely), and the evidence is “evolving” (instead of being final evidence). This concern with modalization is clear from the role of the WHO as “advisor”: the word “advice” and its variations appear four times. Instead of merely creating an obligation, the use of modality of the author encourages the use of masks (“should” appears four times). The effects of wearing a mask are presented in a semiotically weakened way: the masks “help stop” (instead of simply stop), they “could” be a barrier, and they may “reduce the risk” (instead of eliminating it). This modalization of the effects of mask wearing is then finalized with a quote from a specialist. Dr. Tedros claims that the sole use of masks “will not” protect people, which shows that the reversal of risk communication in this BBC piece is not total. Masks should be used, but they can also not be trusted as a unique solution. Wearing a mask is not an absolute risk eraser, because it is “just one” protective resource among others. The most interesting result of this analysis is that the correction of a previous communication of risk is not a “zero-sum” game, which illustrates the “risky” character of this type of communication. The WHO has “always advised” (this is strongly modalized advice, instead of “sometimes advised”) that some particular individuals should wear masks. Masks can, however, give a “false sense” of protection, which is strongly modalized information because it is “false” (instead of “probably” false). The expression “false sense of protection” (which is abundantly present in news media coverage about COVID-19), acutely encapsulates the problem of modalization in risk communication: you should use a mask to be *potentially* protected, but the mask *should not* give you the feeling that you are protected. This analysis is exemplary in showing modalization as an important semiotic device to present risk information and to counter previous information about risk. However, it also shows that modalization opens the way for “partial reversions” of risk information. This communication practice gives space for contrary information without fully denying the original statement. Our analysis unveils a discourse that can be corrected without ceasing to be partially correct. Modalization shows that a news article, which reverts previous information about risk, can just be a modalization of already modalized risks. In terms of the present research problem, modalization of risk can lead to the communication of an absolute risk (there will always be some risk) or to an absence of risk (this risk will be reverted in the future). However, there is

a need to study modalization beyond the word level to answer the problem of the SCCR.

In terms of a Foucauldian discourse–power analysis, semiotic analysis shows that modalizers produce a struggle for meaning that can be reappropriated and used against its original use. This possibility of struggle happens through discourse when actors use words to “invert their meaning, and redirect them against those who had initially imposed them” (Foucault, 1977, p. 151). In the case of the BBC article, the WHO of the present inverts a modality against the WHO of the past to guarantee its power of enunciating the level of risk in the future. To produce a weak modality about risk opens the way to revert that modality without losing the power to establish risk in the future, which means that the WHO is “always partially” correct. The power of the modality of risk operates more effectively through flexible and strategic reversibility, meaning a “certain incertitude” of change, than by the imposition of a strong certitude that could be entirely rejected in the future. This type of dynamic struggle operates through reversible words and also through words that have a weak modality. As Motta-Roth and dos Santos Lovato (2011) argued, science in the media is prone to discursive modalization, which shows the open character of science. In the case of questions of risk, this modalization seems to leave everything at the same level of risk. The correction of information was already presupposed by the corrected modalization, and the correcting modalization protects itself from future corrections. This process produces a discursive layer that protects against political responsibility while it retains the power to enunciate risk in the future. In this case, power does not work by dictating the necessity of something or by reducing possibilities (what Foucault, 1978 called the “repressive hypothesis”). The WHO instead says that the future will be different. Through its use of weak modality, the power of scientific–medical policy of the WHO extends through the future. The organization is thus protected from radical contestation by enabling flexible changes in the open field of possibilities. This intense use of modalization presents a good example of the second version of post-truth. We are not dealing with a question of lying or deceiving, but with managing the political implications and power effects of correcting information in a way that does not destroy the political credibility of the WHO to make more uncertain assertions about risk in the future. The WHO is thus engaged in a fight to be associated with the truth in the future.

The BBC news article, however, gives more linguistic cues to understand risk management in science communication. One of them is the modalized *modus operandi* of the WHO that seems to be, by its institutional configuration and international role in the government of health, a “modal institution.” The WHO is an “advisor” and implies that it advises through “possibilities” (e.g., “countries **can** or **should** do that”). The WHO is not a legislator or producer of new scientific knowledge (e.g., the law is **necessarily** this; our scientific results resulted **necessarily** in this). Another relevant clue concerns a change of position that seems justified by a new situation, namely when the author claims that masks “**should** be worn in public where social distancing is **not possible**.” These two examples suggest that is not only the semiotics of modalization that plays a relevant role for the

SCCR but also for “*ethos*” (the WHO) and the conditions for risk information (the impossibility of social distancing). The analysis, therefore, needs to focus on other aspects of this kind of news to understand how risk is communicated and corrected.

The *ethos*, *logos*, and *pathos* of Risk in the Euronews Article

The approach to the semiotics of modalization in SCCR can be enriched by analyzing how modality is present in the three rhetorical dimensions of *ethos*, *pathos*, and *logos*. This study analyzes how the subjects, reasons, and audience of communication are associated with more or less certainty. It also presents a rhetorical-modal analysis of another news article that shows an attempt at correcting risk. Furthermore, it provides an answer to the following question: How are *pathos*, *ethos*, and *logos* modalized in the correction of risk communication?

The Euronews piece was published on May 7th, 2020 and focuses on the controversy concerning the low probability of COVID-19 infection in smokers in comparison to non-smokers. The article tries to reverse the risk of previous science communication. In the following excerpt, the text indicates where the reversion is semiotically marked (underlined), and the use of modalities (bold). Furthermore, the article analyzes how *ethos*, *pathos*, and *logos* are related to the identified modalizations.

Coronavirus and smoking: What does the World Health Organization say?

Given that tobacco use is thought to kill an **estimated** eight million people every year, a recent report that claimed that smokers were **less likely** to contract coronavirus raised eyebrows. The **preliminary** study, by the Pitié-Salpêtrière Hospital in Paris, stated that “current smoking status **appears** to be a protective factor against the infection by SARS-CoV-2.” Pitié-Salpêtrière Hospital wrote that “nicotine **may be suggested** as a **potential** preventive agent against COVID-19 infection,” based on scientific literature and the hospital’s own observations. But the study also warned that “nicotine is a drug of abuse responsible for smoking addiction.” “Smoking has **severe** pathological consequences and remains a **serious** danger for health.” Despite this, the new information has **clouded** evidence about the relationship between smoking and COVID-19, the disease caused by the novel coronavirus. So what do world health experts say? Are smokers **less likely** to contract the virus? No. According to the World Health Organization (WHO), those who smoke are **likely** to be more vulnerable to infection. “Smokers **may** also already have lung disease or reduced lung capacity which would **greatly** increase the risk of **serious** illness.” “Conditions that increase oxygen needs or reduce the ability of the body to use it properly will put patients at **higher** risk of **serious** lung conditions such as pneumonia.” Studies also show that smokers were **more likely** to die than non-smokers during the Middle Eastern Respiratory Syndrome (MERS) outbreak in 2012. “People who smoke have **poorer** lung health, so you’re already starting at a **poorer** baseline,” said Dr. Sara Kayat, a UK GP. (...) It is also theorized that smokers are **more** at risk of infection because of the effect tobacco can have on ACE2 (angiotensin-converting

enzyme II) receptors. These gene expressions are located in human cells, and notably in the respiratory system. “COVID-19 needs to sit in this receptor to spread and duplicate, and we also know that smoking can up-regulate this receptor, so it can create more of these receptors for COVID-19 to sit within,” Dr. Kayat told Euronews. “It **may** be that this is how smoking **might** contribute to a **higher** risk of serious consequences.” A report in March by the European Centre for Disease Control (ECDC) has also identified smokers as a “vulnerable group” to infection from COVID-19, due to the “**higher** susceptibility” of ACE2 receptors. Meanwhile, the World Health Organization have also **suggested** that the very act of smoking increases the possibility of virus transmission. “Fingers are in contact with lips... and smoking products such as water pipes often involve the sharing of mouthpieces and hoses, which **could facilitate** the transmission of COVID-19 in communal and social settings.” But while smoking does have a number of negative connotations, there is **little** evidence to supplement this theory. “There **may** be **higher** risks of severe outcomes from COVID-19, but whether or not smokers are **more likely** to catch COVID-19 is **still up for debate**,” Dr. Kayat told Euronews. “I would not **suggest** using smoking as a way of preventing getting coronavirus, and **certainly** cutting back on your use of tobacco **may help**.” (...) A local Foundation Trust for the UK’s National Health System has released information about the coronavirus that there is “an **increased** risk for people who smoke.” “If you are going to give up smoking, this is a **very good** moment to do it,” said Chief Medical Officer, Prof. Chris Whitty. NHS guidelines also state that smoking **increases** the risk of “more than 50 **serious** health conditions.” The French Health Ministry has stated that smokers are not **more** at risk of contamination, but they are “**more** at risk of developing **serious** conditions.” France has **severely** curtailed the sale of nicotine products after the recent study in Paris. Pharmacies are now limited to selling no more than 1-month supplies of any nicotine products aimed at curbing dependence on cigarettes. Meanwhile, the online sale of products has been banned **altogether**. The Health Ministry said the measures were taken to “prevent the health risk linked to the **excessive** consumption or misuse” of nicotine products by people hoping to protect themselves from COVID-19. The Pitié-Salpêtrière hospital in Paris is planning to clinically test the use of nicotine patches on hospitalized COVID-19 patients to investigate their theory. Researchers are nevertheless not encouraging citizens to take up smoking, due to other **potentially** fatal health risks that are involved.

Focusing on *ethos*, this is a text full of experts and their institutions: Pitié-Salpêtrière Hospital, the WHO, the GP Dr. Sara Kayat, the European Centre for Disease Control, the “local Foundation Trust for the UK’s National Health System,” Chief Medical Officer Prof. Chris Whitty, the NHS, and the French Health Ministry. There is no explicit semiotic modalization of the various *ethe* involved. However, this study suggests that the news article uses institutional and geographic modalization by the way it convokes the different types of *ethos* of the actors. The hospital evidence is counteracted by specialists from medical

institutions (GP Sara Kayat and Chief Medical Officer Chris Whitty) who share the same expertise as the hospital. National health institutions (the NHS and French Health Ministry) and international entities (the WHO and European Centre for Disease Control) are positioned against the local evidence from Paris. This multiplication of *ethos* against the low risk suggested by the study of the French hospital seems to work as a strong modalization for the high risk that is communicated by this majority.

In terms of the modalization of *logos*, reasons, the French hospital presents its evidence in a highly modalized way. They weaken their affirmations through “**preliminary**” research. The hospital claims that the result “**appears**” to be true. Finally, the researchers from Paris express that “nicotine **may be suggested** as a **potential** preventive agent against COVID-19 infection.” The researchers of the hospital, however, also stress with a strong modality that tobacco is linked to addiction, which causes “**severe**” diseases and is a “**serious**” danger for the health of people. The reasons presented in opposition to the hospital claims are expressed in a modalized way that increases their certitude. For instance, the WHO claims that smokers are “**more**” vulnerable, smoke will “**greatly**” increase risk, its users will have “**serious**” illnesses, the risk of severe outcomes from COVID-19 will be “**higher**,” and smokers are “**more likely**” to die. However, a careful reading of the article shows that these reasons do not contradict the initial evidence advanced by the Parisian hospital. Even if all opposing actors seem to agree upon the fact that the conjunction of COVID-19 symptoms and the risk of disease caused specifically by smoking contributes to a poor health outcome, that consensus is not focused on the evidence of the French hospital on the low probability of smokers *catching* COVID-19. The weak modalization of this probability is clear in the quotation of Dr. Kayat when she says that the issue is something that is “**still up for debate**.” The reasons (*logos*) that are strongly modalized by the majority are not directed toward the probability of both smokers and non-smokers *getting* the virus, but mostly toward the risks of smoking *once* one is infected with COVID-19.

This leads to the analysis of the modalization of the *pathos* (the audience) of this text, which mixes two types of audiences: (1) smokers as high-risk subjects given the dangerous interaction of smoke-related diseases or vulnerabilities and the additional complications of COVID-19 *once* they get the virus; and (2) smokers as probable “*catchers*” of the virus in comparison to non-smokers. The way the two risks are mixed, the first is presented as a high risk, and the second as an unknown risk that is probably reduced according to the hospital study, seems to legitimate an intervention directed at the “audience” (smokers and potential smokers) through the political control of the availability of nicotine patches. However, this political control appears to be unjustified in terms of the risk of contagion, even if it is justified in terms of the risk of smoke-related diseases. The objective of this control, expressed in strong modalization, is to manage the dependence of smokers by “**severely**” reducing the offer of nicotine products and making sure that online sales are “**banned altogether**” to control “**excessive** consumption or misuse.”

The weak modalization of the low risk of smokers catching COVID-19, according to the hospital study, gives rise to a news article that reinforces the modalization of other types of risk. This interaction happens because a reduced COVID-19 risk for smokers can increase the number of smokers, therefore augmenting the risk of smoke-related diseases and the risk of a poor outcome if the smokers suffer from COVID-19. In the absence of strong evidence (*logos*) of the probability of smokers catching COVID-19 that could be used to oppose the reasons (*logos*) of the French hospital, this risk communication reinforces the power of the modality of *ethos* (the multiplication of international experts and health institutions) and *pathos* (reducing the opportunities to buy nicotine). The result of this rhetorical-modal analysis of SCCR shows that the modalities of risk can be rhetorically presented in different ways and degrees according to *ethos*, *logos*, and *pathos* dimensions, and they need to be analyzed carefully. In the case of the Euronews article, there seem to be no reasons (*logos*) to justify a strong intervention directed against the audience (*pathos*) besides the majority of institutions and specialists (*ethos*) agreeing about a high risk (the poor outcome of smokers infected with the virus) that can be augmented due to the communication of the low risk of other evidence (the low probability of smokers catching COVID-19). This example shows that the opposition to the risk communication of the French hospital with the evidence of *indirect* risk by the majority of the actors in the text has produced a communication in which risk is absolute. Smoking is so dangerous during a pandemic that it justifies the control of the public purchase of nicotine. This approach, however, fails to address the specific risk that the French hospital study wants to emphasize.

The power relations that can be described through a rhetorical analysis of modalizers in the Euronews piece show how different agents use their medical authority to establish links with political authorities, thus producing an exchange of legitimacy and power. Foucault already studied this phenomenon in the constitution of the forensic sciences. The judicial power received epistemic authority from the Psy-sciences to understand the criminal, and these sciences obtained the power to participate in and influence judicial decisions (e.g., determining legally imputable criminals according to their mental health status) (Foucault, 1979). The risk of smoking in the context of a pandemic is strongly modalized by associating medical authorities with the political capacity to control the actions of the audience. The number of authorities (*ethos*) and the capacity to politically control the audience (*pathos*) made the risk high, not the reasons (*logos*). This level of risk is thus reinforced through a political-medical association. Rather than appealing to *logos*, the correction of risk here occurs through controlling the nicotine market. This decision is then justified by the multiplication of medical-political *ethos* against the freedom of choice of the audience (*pathos*). Although Motta-Roth and dos Santos Lovato (2011) suggested that science news is dominated by scientific actors, in the Euronews article we can see different political actors (even if they are linked to scientific and health domains) participating in the news. When science is more visibly entangled with risk issues, other non-scientific actors enter the discursive field. However, this political intervention follows

scientific advice, which legitimates political actions and gives power to science. Curiously, this struggle between *ethos* and the control of *pathos* on the effects of the reception of discourse shows that there is a mixed encounter between the first and second versions of post-truth. It is not a question of an absence of *logos*, but a lack of confrontation between the merits of the two reasons that carry different levels of risk: the risk of smokers contracting COVID-19 vs. the risk of a dangerous outcome for smokers *once* they are infected. The political-medical institutions do not know what the risk is of a smoker contracting COVID-19 (*logos*), but they are sure that doubt is dangerous for the public (*pathos*). The institutions, thus, have a presupposition about the irrationality (a lack of *logos*) of the public. The struggle for establishing the risk of these two scenarios is not made through evidence alone but mostly through the power of institutions (*ethos*) that can make the modality of risk stronger when there are doubts about reasoning (*logos*).

This analysis also shows that *logos*, *pathos*, and *ethos* are not just discursive dimensions, but they produce a network of material elements that together produce risk communication beyond its discursive character. Thus, it becomes evident that it is necessary to analyze how the materialities of risk give rise to an SCCR that is not just linguistically and rhetorically shaped. For instance, the *ethos* of the WHO is already a combination of past reasons (*logos*) of state-nations that support the institution to operate in a coordinated way in health matters. The WHO also has an already defined audience (*pathos*) of health-related governmental stakeholders. These elements of *logos* and *pathos* are encapsulated in the governmental advisory task of the *ethos* of the WHO. In the same way, rhetorical control of the behavior (*pathos*) of the audience through the reduction of the sale of nicotine already presupposes an *ethos* of the State and a *logos* of the rule of law. Finally, the presentation of evidence by hospitals and medical doctors (*ethos*) relies on the epistemic and technical capacity of biomedical experimentation (*logos*), which makes their *ethos* an epistemic authority or creates credible expertise. An identification of how the modalization of risk differs across *ethos*, *logos*, and *pathos* is not enough. It is also necessary to understand how risk communication is constituted in the face of the networked materialities of risk.

Actor–Network Theory Analysis of Modality in the *TIME* Article

Latour proposed to extend the semiotic classic focus on textual meaning with ANT, which makes semiotics a more general enterprise of finding meaning production despite its substrate, its types, and forms of materialization. By focusing on “path-building or order-making or creation of directions, one does not have to specify if it is language or objects one is analyzing” with ANT (Latour, 1996, p. 377–379). This method allows, on the one hand, to approach objects as a language and as meaningful, and, on the other hand, to view languages and meanings as objects. It is this methodological move that makes a “new continuity” between language and matter possible. This move can be understood as either “to elevate things to the dignity of texts or to elevate texts to

the ontological status of things” (Latour, 1996). This “new hybrid status gives to all entities both the action, variety and circulating existence recognized in the study of textual characters and the reality, solidity, externality that was recognized in things ‘out of’ our representations” (Latour, 1996). In short, this approach gives meaning to things and materiality to words. Playing with the title of a famous book on pragmatics, Latour claims that through ANT we can see how the world does “words with things and things with words” (Latour, 1990, p. 63). This study used ANT as a method to understand how the discursive modalities of risk became stronger or weaker through the material relations of SCCR. The question that the article address is the following: *How do the networks of materialities influence modalizations in the correction of risk communication?*

In the following analysis of a *TIME* article, the text indicate the discursive marks of the correction (underlining) and modality (bold) of SCCR. And it also indicates when the words are associated with a hyperlink to another site (with italics). Following the relational and material method of ANT in the analysis of this June 9th of 2020 article, the analysis especially focuses on the use of hyperlinks (these links materialize a relation to another place through physical servers) and on a video that is presented at the beginning of the news piece.

Unpacking the *New* WHO Controversy Over Asymptomatic COVID-19 Transmission

For months, *researchers have warned* that people without any COVID-19 symptoms could still be silent carriers of the disease, making it that much harder to get the pandemic under control—and that much more important to take precautions like *social distancing* and wearing a mask, even if you feel fine. So it came as a *surprise* when Maria Van Kerkhove, the World Health Organization’s (WHO) technical lead for COVID-19, said at a press briefing on June 8 that asymptomatic transmission **appears** to be “**very rare**.” Her statement came just days after the *organization directed* healthy people living in areas with widespread community transmission to wear fabric face masks in public to **help** contain the advance of the disease. In an interview with *TIME* following the press briefing, Van Kerkhove said she did not mean to **suggest** that asymptomatic people cannot spread COVID-19. “I did not say that asymptomatic cases **cannot** transmit; they **can**,” Van Kerkhove says. “The question is, do they? And if they do, how often is that happening?” Van Kerkhove says there’s not yet a clear answer, but the WHO’s analyses **suggest** symptomatic individuals are responsible for most coronavirus transmission. (She also clarified during a June 9 briefing that her comments were in response to a journalist’s question, and did not constitute official WHO policy). The WHO laid out its thinking in its latest guidance on face masks, which was *circulated on June 5*, and was based on several *reports* that examined COVID-19 community spread and transmission dynamics, as well as not-yet-published findings from contact-tracing reports from multiple WHO member states. Few of the cited papers explicitly examined population-level asymptomatic transmission rates. One, a *preprint* (i.e., *not-yet peer-reviewed*) *research review* posted to the site MedRxiv

on June 4, analyzed four previous studies (two published and two preprint) that estimated asymptomatic transmission rates. The highest estimate was a transmission rate of 2.2%, **suggesting** “asymptomatic spread is **unlikely** to be a major driver of clusters or community transmission of infection.” The WHO’s guidance also notes that some studies that have found evidence for asymptomatic transmission had small sample sizes, which would make their findings less statistically relevant. In addition, the WHO said, some of these studies did not rule out alternative explanations for how some patients **may** have contracted the virus, like touching a contaminated surface. However, just last week, researchers from the Scripps Research Translational Institute *published a paper estimating* that asymptomatic individuals account for up to 45% of coronavirus cases, and noted that “the viral load of such asymptomatic persons has been equal to that of symptomatic persons, **suggesting** similar potential for viral transmission.” One of the study’s author’s, Scripps Director Dr. Eric Topol, criticized the WHO’s comments on Twitter, *writing that* “there are *several studies* not included in [the WHO’s] brief statement that counter the scant data provided here.” Carl Bergstrom, a biologist at the University of Washington, *wrote on Twitter* that the WHO’s conclusions were based on “thin evidence,” at least when taking into account what has been published publicly. Bergstrom also said the organization **should** have more clearly distinguished between people who are “truly” asymptomatic—those who never show symptoms—and those who **may** unwittingly spread the disease in the days before they become symptomatic. Topol’s study on asymptomatic transmission found that few people who test positive without symptoms go on to develop them, but *studies suggest* it takes an average of 5 days after exposure to the virus for symptoms to surface. People in this phase would be considered pre-symptomatic, not asymptomatic, but it’s difficult to tell the difference. “Even if truly asymptomatic spread is **very** rare, pre-symptomatic transmission is **likely** to be important,” Bergstrom wrote on Twitter. “We still need to wear masks and distance to avoid spreading the virus during this period, probably concentrated in days 3–6 after infection.” Van Kerkhove acknowledged that distinction when speaking with *TIME* after the press briefing, and added that it **can** be difficult to distinguish between a mildly symptomatic and asymptomatic person. Some people may not associate mild symptoms—like fatigue or muscle aches—with COVID-19, but these individuals would still technically be symptomatic and *capable of spreading the virus*, Van Kerkhove says. With **so much** uncertainty, Van Kerkhove says more research on transmission patterns and asymptomatic carriers is required. She says people **should** continue following public-health guidance such as wearing fabric face masks when social distancing is not possible, and **should** stay home if they feel unwell. Doing so, in conjunction with robust *contact tracing* and isolation of people with symptoms, will **help** keep COVID-19 spread under control, she says. “We’re not ruling anything out,” Van Kerkhove says. “We’re not saying that [asymptomatic spread is] not happening. But we’re saying more transmission is happening among symptomatic

individuals. People are looking for a binary, and it’s not that.” Bergstrom was more direct. The WHO’s statement “**seems to suggest** that people without symptoms don’t spread COVID19,” Bergstrom tweeted. “Does this mean shoppers, students, protesters, etc., don’t need masks/distancing? No.”

Two types of materiality seem relevant for risk communication in this article: (1) a video of the statement that is the object of correction; and (2) the proliferation of hyperlinks in the text. After the title of the news piece, there is a 30-s video of Van Kerkhove claiming that there is a low risk of transmission by asymptomatic individuals. This statement about risk information that the *TIME* article corrects only lasts 5 s. The remaining 25 s are about the importance of tracing symptomatic individuals. In that 5 s, we hear: it “still **appears** to be **rare** that an asymptomatic individual actually transmits onwards.” This comment contradicts the “**very rare**” modalization that is attributed to the technical lead of the WHO in the article. In terms of the ANT analysis, the video is a visual materialization of the responsible speaker discussing risk information and produces more “veracity” in comparison to just text. This approach means that the modalization of the video materiality makes the claim stronger because we can see the person who is saying the words and have access to the authority that is associated with a WHO press conference. Given the privileged space that is given to the video, and the speed of visual media in presenting information in comparison to the textual quotation of Van Kerkhove later in the text, we can observe a form of “material modalization” that is made possible not only by the type of medium used but also by its place on the news website.

Given that in the text Van Kerkhove corrects her claims, suggested that the video is used as a “narrative of guilt” that asks to be solved later in the text. The clip can be interpreted as a type of “shame-inducing” that demands reparation. This type of risk communication foregrounds particular risks by first presenting something that has already been denied and only later offering the needed correction. The journalists could instead just have published a video with the most correct and updated information. Van Kerkhove said in her defense that her claim was a reaction to the question of a journalist and did not constitute the official policy of the WHO. The guilt narrative strategy of *TIME* magazine does not include the questions of the journalist, which could have provided other cues for understanding what was answered. The interaction between the WHO and the news media is a discursive materialization that constitutes one of the most important sources of public risk communication, and the interaction could have been made available. It is also interesting to note that the answer to a journalist does not constitute official policy even if this statement is made at a public briefing of the WHO. This interaction shows that risk communication is not just about communicating all types of low and high risks because there is an “official policy” that distinguishes between what is an authorized communication of risk and what not. This article is an interesting risk communication piece because it (1) states that something rarely occurs (asymptomatic transmission); (2) it corrects that information with a statement that casts doubt about its degree of occurring, and, finally, (3) it is presented

as “unofficial” discourse because the speaker crossed a certain WHO political line about the public enunciation of risk when talking to a journalist. Van Kerkhove modalizes what is said through materialization of the speech situation: what is said by the WHO is certain, what is said to a journalist is uncertain. This situation gives us the sense that risk is institutionally negotiated, and there is a risk of talking about risks that are not officially approved. This state of affairs reveals that the enunciation of risk can also constitute the management of the authority. Thus, journalism plays a role in questioning the authority associated with official risk assessment and communication. The materiality of the video and the interaction between health authorities and journalists are important clues for the communication of risk during a pandemic that goes beyond discursive indexes. The *TIME* piece shows that modalization changes according to the types of media, the interaction, and the speakers involved, and the institutions that materialize the speech situation.

The hyperlinks used in the article are abundant. The piece first presents two hyperlinks to previous *TIME* articles concerning the advice of researchers about the need for social distancing, even from people who appear to be healthy. The statement of Van Kerkhove is contrasted with yet another hyperlink from *TIME* magazine about the advice of the WHO on the use of masks. The hyperlink to the advice of the WHO is also present in the text and is backed up by another hyperlink from the CDC about scientific reports that support that advice. The evidence in favor of earlier remarks of Van Kerkhove is available in a hyperlink to a non-peer-reviewed paper on medrxiv.org. This paper is, in turn, contradicted by another *TIME* hyperlink to a published and peer-reviewed paper. The Twitter account of a researcher (Dr. Eric Topol) is also shared, which in turn has a hyperlink to medrxiv.org where studies are available that support the evidence of the study of Topol. Another Twitter account of an expert (Carl Bergstrom) is presented, critiquing the technical statement of the WHO of not being informed by what has been published on the matter. *TIME* again cites another one of its articles referring to the work of Topol and includes a link to the scientific journal *Nature*, both of which contradict the “very rare” thesis. The last link is another hyperlink to a *TIME* article about the process of tracing individuals who have been infected with COVID-19.

This description of the abundant use of hypermedia links shows that the link to another text can operate as a backup justification for what is being read in the text of the article itself. The materiality of the link is an important modalization for risk communication, given its archival and testimonial character. A phrase with a link becomes more certain because it has already been reported elsewhere. Information is thus repeated and justified. The article engages with a multiplication of links to correct risk information and follows a quantitative strategy. The problem, however, is that each of these links comprises its own risk communication and modalization of uncertainty. The links to medrxiv.org or Twitter are cases in point of non-peer-reviewed information for science communication. Another important risk is linked to the economy of news media. *TIME* only cites its

own past articles, and thereby follows the competitive logic of the news media market, instead of quoting the best information available independently of news media source. This line of action is one classic phenomenon of “gatekeeping” (Tuchman, 1978), which is systematically studied in communication research. The communication of science, therefore, not only has to deal with competing types of scientific information but also with competing news providers. The social and economic value of a news piece depends on its novelty in comparison to other media players and does not only depend on its certitude. Media competition determines the course of gatekeeping, namely by excluding important information about risk that has been made available by other sources.

The hyperlinks in the *TIME* article also carry the risk of being left unread and just used as a materialization of a text that can “act.” In other words, it may “conduct” us to other texts that legitimize what is being currently said. This sequencing demands an extremely active reader if he/she is to follow all the links that are offered to him/her. Concerning the general problem of the communication of risks that does not engage in either communication free of risk or unjustifiably exacerbates risk, this ANT analysis shows that the *TIME* article tries to produce a balanced narrative through the display of diverse links and the different claims of Van Kerkhove. However, the way the article uses video and hyperlink resources may produce a form of communication of risk that downplays the risk involved too much. The video shaming strategy suggests that it is easy to make a judgment about the risk and uncertainty of scientific information, and it is not complicated to find culpable individuals. The hyperlinks demand an active reader who follows the justifications for what is being read and create the impression that they are risk-free archives of testimony.

In terms of an analysis of the power effects of discourse, the journalists correct information about COVID-19 while they are in a power relation with official sources. This struggle extends to biomedical researchers who contest the level of risk conveyed by the WHO. The media in question also tries to produce a discourse of risk that takes into consideration the tactics, strategies, and powers of media competition in a market of information. The case of *TIME* magazine seems to be an example of science communication characterized by the first version of a post-truth situation. Apparently, it is a text in which the question of falsity seems to be pervasive. Two elements seem to justify this reading. Although the WHO spokesperson said something that is not true according to the existing scientific evidence, the media also did not quote the right modal word that the spokesperson used. The opportunity that the spokesperson was given to correct the information of risk showed that this was a moment of struggle through the exigence of truth. This case, therefore, also applies to the second version of post-truth. A fight concerning truth, and not falsity, characterizes the struggle between scientists who produce scientific evidence and the WHO as the institution that decides to use that evidence to recommend courses of action. These various actors use the truth to fight for the definition of the level of risk.

CONCLUSION

Science communication is in many ways a daughter of risk. The German historian Koselleck (1988, p. 1; 7–8) famously suggested that there is a connection between the concepts of “critique” and “crisis” in the Enlightenment discourse of the 18th century. These concepts were used during a time when knowledge was important for criticizing absolutist regimes that were in crisis. Communication studies are also immersed in this conceptual history because it has been strongly linked to a critique of political mass propaganda, especially during the Cold War crisis. Military tension motivated the research and critique of “mass media effects” and their role in mobilizing people for war efforts (Glander, 2000). Science communication, which follows the Enlightenment tradition and Communication Studies concerns with political effects, shares this conceptual nexus of crisis and critique. The communication of science became more urgent due to a need to repair the crisis in public trust and financing during the post-war period, given that science had played a decisive and criticized role in war efforts (Miller, 2001). Investment to increase the number of scientifically literate people, in order to make them adapt to a more sophisticated industry, also reduces the risk of unemployment. The fight against national and international economic stagnation was thus an important motive for investing in science communication (Shamos, 1995). The communication crisis associated with Genetically Modified Organisms has shown the limits of approaches based on the public intake of scientific facts without a dialog on ethical, economic, political, and social matters (House of Lords, 2000). Finally, science communication has newly faced crisis and critique through recent issues of post-truth (Reyna, 2020), fake news (Scheufele and Krause, 2019), and the denialism of science (Oreskes and Conway, 2010). The current pandemic is an urgent topic for communication research because as a situation of crisis it creates and demands critique and is immersed in the post-truth phenomenon. The virus is not only a source of risk for public health and communication strategies (Cuan-Baltazar et al., 2020; Krause et al., 2020, p. 19; Li et al., 2020), but the proper idea of truth and scientific evidence was also already at risk during the post-truth crisis. Thus, we are facing a double risk with the science communication on COVID-19. Taking into consideration this double risk, it is important to understand how risk about COVID-19 has been communicated in the news media.

The three types of textual analyses proposed in this article give us three important results about how risk correction in news media of COVID-19 topics is modalized. The results highlight how difficult it is to correct risk information without producing more risk or devaluing relevant risk. In the first case (the BBC), a simple modal analysis showed that a modalized risk can always be reverted or partially correct, which makes the role of SCCR textually challenging. The second case (Euronews) presented the difficulties of managing risk when different types of risk are combined. In this article, the reasons (*logos*) of certain risks were overlooked due to the prominent use of the *ethos* and *pathos* dimensions of risk. The last case (*TIME*) focused on the importance of the materialities of risk communication, namely

the use of video and hyperlinks that can increase the amount of risk involved.

The analysis of semiotic, rhetorical, and material modalities has proven to be productive. (1) Semiotically, the number of modal words is higher than the words that express the change of the corrected information. This finding suggests that the correction does not totally reverse previous information but introduces uncertainty to protect the author from communicating information that could be heavily corrected in the future. The interesting result is that the correction of risk can be characterized by a strategy of inserting more, not less, uncertainty. (2) In rhetorical terms, when there is a correction of information, the *ethos* and *pathos* dimensions of discourse can be more prominent than the discursive dimension of *logos*. It could be expected that *logos*, reason, would be the more relevant discursive element because it is *logos*, or rationality, that is supposed to require correction when things are uncertain and risky. However, the result indicates a proliferation of the “social” dimensions of discourse, namely *ethos* and *pathos*. The correction of information is about more than just correcting facts and reasons, and the social dimension of science communication shows that it is not just a question of literacy or understanding. (3) In terms of a socio-material analysis of discourse, a recourse to the materiality of hyperlinks can increase, instead of reducing, the risk that the correction of information tried to counteract. A multiplication of sources of information does not just add more backup information. The hyperlinks in the *TIME* piece are accompanied by the uncertainties that those sources carry. Although these hyperlinked sources are not visible, they demand additional interpretative work from the reader. Readers, thus, need to follow and compare the different links and how they really justify one another.

This study concludes by identifying the political implications that the results present while focusing on the problems associated with the communication of uncertainty and risk. The science communication on uncertainty and risk needs to be understood along with the topic of post-truth, as presented in its second version. The problems of communicating uncertainty and risk could be associated with the issue of revealing “too much truth” that can negatively impact some vulnerable publics (as is the case in the *Euronews* article). As such the *Euronews* article offers an example of the problems of communicating uncertainty to audiences that are prone to be suspicious of science (as is the case in a post-truth situation). However, these problems will provide limited options for debate if we do not take seriously the thesis that the communication of science is inevitably associated with power effects and political consequences. This means that the problem of communicating uncertainty and risk needs to take into consideration the power associated with the communication of different degrees of uncertainty and risk. That is, we need to analyze who will lose and who will win. Will scientific institutions maintain their social capital of trust if they disclose uncertainties that could produce political contestation? Which audiences will benefit from or be harmed by that disclosure or hiding of uncertainty? When should publics or scientific institutions ask for more power to question uncertainty? To answer these questions, it is not enough to study the production

of news but it is also necessary to study the reception of news. How do different audiences interpret and reappropriate the levels of risk and uncertainty that are in dispute during the correction of risk during the COVID-19 crisis? Recent research suggests that a lack of consensus among experts produces more public distrust than uncertainty in terms of data (Gustafson and Rice, 2020). This is an important insight for understanding what could be the effects of the Euronews piece, given that the consensus among the different *ethes* trumped the discussion of evidence.

It is difficult to believe that it will be possible to communicate uncertainty and risk without taking into consideration the political and power effects associated with a complex pandemic situation. More importantly, it is not advised to do so. Our post-truth situation demands that we should be cautious concerning the intended and unintended power effects of science and its communication. This analysis has already shown how a simple language function, modality, that is used to control and correct risk does not cease to produce possibilities of augmenting that risk. This persistence of risk correlates with power effects. In the case of the BBC news piece, this irreducible level of risk shows how the WHO tries to maintain its power as an advisor. The WHO enunciates risk through its use of modalities that protect it from losing its power to advise in the future. The Euronews example clearly showed how the uncertainty of risk about potentially dangerous information more strongly mobilized the *ethos* dimension of discourse against certain dangerous reasons (*logos*), than introducing a multiplication of reasons. In addition, the control of the effects of the reasons on the audience (*pathos*), by reducing its liberty of choice through market restrictions, is a clear political intervention with regard to reducing risk. Finally, the *TIME* news piece shows a struggle among three dimensions: (1) a fight for what constitutes “official” risk enunciation during

the interaction with journalists and a WHO advisor; (2) a display of the logic of the economy of attention that is associated with the competitive behavior of news media that privilege their own information; and (3) the struggle that different biomedical researchers have with the WHO to establish an appropriate level of risk. We can suggest from this qualitative study that the correction of risk communication should not just be the addition of modalizers, or the need to scrutinize how the three rhetorical modes influence the degree of that modalization, or point us to being careful concerning the impact of online materialities of communication. We also need to take into consideration political implications, power effects, the effect that the correction of risky information has on different publics, scientific institutions, political decisions, and media. Who sets the risk? What risks can be contested? Where can we discuss them? When can we debate the risks? How can we determine the risk?

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Cultural Cognition and Ideological Framing Influence Communication About Zoonotic Disease in the Era of COVID-19

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The efficacy of science communication can be influenced by the cultural values and cognitions of target audiences, yet message framing rarely accounts for these cognitive factors. To explore the effects of message framing tailored to specific audiences, we investigated relationships between one form of cultural cognition—political ideology—and perceptions about the zoonotic origins of the COVID-19 pandemic using a nationally representative Qualtrics XM panel ($n = 1,554$) during August 2020. First, we examined differences in attitudes towards science (in general) and COVID-19 (specifically) based on political ideology. We found that, compared to conservatives and moderates, liberals trusted science more, were less skeptical of science, perceived greater risk from COVID-19, were more likely to believe in a wildlife origin of COVID-19, and were more likely to support restrictions on wildlife trade. Second, we examined the influence of cultural framing on the perceived validity of science related to COVID-19. Respondents were randomly assigned to one of three treatment groups: 1) a technocratic framing that highlighted feats of human ingenuity to overcome zoonoses; 2) a regulatory framing that highlighted regulations and expansions of protected areas for wildlife as a means to prevent zoonoses, and 3) a control article about traffic lights with no cultural framing. After reading the initial framing article, all three groups read the same fictional, yet factually accurate, 'Nature Science study' generated by the authors. An OLS regression model revealed a significant interaction between the technocratic framing and political ideology. Relative to the control group, the technocratic framing slightly increased perceived validity of the Nature Science study for conservatives, significantly lowered perceived validity for liberals, and had no impact on moderates. We did not detect any significant interaction between framing and political ideology for the regulatory framing. Findings of this study highlight the need to account for cultural cognitions when communicating about COVID-19 and other zoonotic diseases. Communication strategies carefully designed to resonate with ideologically diverse audiences may ultimately lead to bipartisan support for actions required to promote "One Health" approaches that reduce the impacts of zoonoses on human and environmental health.

Keywords: coronavirus—COVID-19, message framing, one health, political ideology, science communication, wildlife, zoonoses

INTRODUCTION

The COVID-19 pandemic has highlighted the critical need to improve communication about zoonotic disease to mitigate global threats to the health, safety, and financial stability of the global community, including both humans and wildlife (Daszak et al., 2000; Cunningham et al., 2017; Henig, 2020; Nuwer, 2020). The World Health Organization (WHO) define zoonotic diseases as “any disease or infection that is naturally transmissible from vertebrate animals to humans” (World Health Organization, 2020); a definition that encompasses the COVID-19 pandemic. To be effective, communication about zoonotic disease may need to account for cultural values and worldviews. The cultural cognition thesis suggests individuals process information through the filter of their worldviews and accept or reject facts based on their beliefs about how social systems should function (Kahan et al., 2010). For instance, those with hierarchical and individualistic worldviews tend to downplay environmental risks, as they believe addressing them would threaten hierarchical social structures and restrict the free market (Kahan et al., 2008). In contrast, those with egalitarian and communitarian worldviews are more likely to perceive risk from environmental issues and support environmental regulations, as they interpret unrestricted markets as sources of inequality within society (Douglas and Wildavsky, 1983; Kahan et al., 2008). Worldviews are closely tied to political ideology, particularly in the United States, where conservatives tend to adopt individualistic and hierarchical worldviews and liberals tend to adhere to communitarian and egalitarian ones (Wildavsky, 1987; Gastil et al., 2011; van der Linden, 2016). Furthermore, political polarization on key issues has magnified ideological differences based on party affiliation within the United States (Pew Research Center, 2017).

Political polarization has been particularly evident in the context of the COVID-19 pandemic, as news coverage regarding the lethal zoonotic disease has helped to fuel a partisan divide in perceptions of the pandemic, its causes, and its consequences (Hart et al., 2020). Thus, uncertainty surrounding the COVID-19 pandemic can be used as a tool by political elites to reduce trust in science and diminish support for science-based policy (Kreps and Kriner, 2020). Such tactics might further erode trust in science, a trend that is particularly prominent among conservatives (Gauchat, 2012; Funk et al., 2019), leading to higher levels of polarization. Thus, it has become urgent to investigate the influence of political ideology on beliefs about COVID-19 and explore the ability of culturally responsive communication to increase the efficacy of messaging related to zoonotic disease. It is especially important to implement effective communication during pandemics, as rapidly evolving knowledge may lead to widespread misinformation (Vraga and Jacobsen, 2020). Further, better communication can help mitigate future zoonotic disease outbreaks similar to COVID-19 by building public support for proactive wildlife management actions and policy changes needed to reduce disease risks (Hanisch-Kirkbride et al., 2013) and promote biodiversity conservation (Jacobson et al., 2019). This integrated approach reflects a “One Health”

conceptualization of zoonotic disease communication where humans, wildlife, and the environment all become part of the story (Lu et al., 2016; Centers for Disease Control, 2020; Zinsstag et al., 2020). However, the extent to which these new approaches influence the growing polarization of perspectives remains unclear.

Lapinski et al. (2015) called for more testable hypotheses about how different human cognitions influence the efficacy of One Health message framing about zoonotic disease. To address this knowledge gap, we investigated how conservatives, moderates and liberals in the United States differed in their attitudes toward science and wildlife diseases, and how political ideology shaped the efficacy of science communication about COVID-19. To this end, we compared general beliefs about science, specific beliefs about the zoonotic origins of COVID-19, and responses to different types of message framing (focused on technocratic vs. regulatory solutions to prevent zoonoses) among three groups with different political ideologies. Our first set of hypotheses focused on investigating different beliefs and perceptions about science and the pandemic based on political ideology:

H1: Compared to conservatives, liberals and moderates will exhibit more trust in science.

H2: Compared to conservatives, liberals and moderates will be less skeptical of science.

H3: Compared to conservatives, liberals and moderates will perceive greater risk to human health, safety, and prosperity associated with COVID-19.

H4: Compared to conservatives, liberals and moderates will express more belief that COVID-19 originated in wildlife.

H5: Compared to conservatives, liberals and moderates will express more support for actions to regulate wildlife trade tied to zoonotic disease transmission.

Our second set of hypotheses focused on examining the influence of different message frames, designed to resonate with certain cultural worldviews (i.e., political ideologies), on the perceived validity of science communication about the zoonotic origins of the COVID-19 pandemic and potential management responses.

H6: Science communication about the zoonotic origins of COVID-19 primed with a technocratic framing (focusing on human ingenuity and technological solutions to zoonoses) will be perceived as more valid among conservatives and less valid among liberals and moderates.

H7: Science communication about the zoonotic origins of COVID-19 primed with a regulatory framing (focusing on regulations to promote the shared health of humans and wildlife) will be perceived as more valid among liberals and moderates, and less valid among conservatives.

BACKGROUND ON ZONOOSES AND COMMUNICATION RESPONSES

As defined by the Centers for Disease Control (CDC), emerging infectious diseases (EIDs) are “those whose incidence in humans has increased in the past two decades or threaten to increase in the near future” Centers for Disease Control (2018). Zoonoses, a

class of EIDs that emerge from wildlife and become infectious to humans, may pose the greatest threats to human health and well-being (World Health Organization, 2020). Several notable human diseases have emerged from wildlife including SARS, Hendra virus, Nipah virus, Ebola, HIV, Malaria, and COVID-19 (Evans et al., 2020). Zoonoses can be deadly or have lasting effects throughout the lifetime of people who are infected. For instance, from 2017 to 2018, Malaria had an estimated death toll of 405,000–416,000 despite continued global efforts to combat the mosquito-borne disease (World Health Organization, 2019). HIV/AIDs, a chronic disease affecting the immune system that originated in wild primates, claimed the lives of an estimated 690,000 individuals in 2019 (UNAIDS, 2020). Encephalitis, acute respiratory distress syndrome, and depression are just a few of the symptoms associated with the Nipah virus, which originated in fruit bats and produced a mortality rate of about 70% in humans when it first spread in Bangladesh and India (Ang et al., 2018). COVID-19 is a recent zoonosis that likely originated from a bat (Andersen et al., 2020) and spread through the Huanan seafood market, which sells various types of live wildlife including poultry, fish, marmots, pangolins, and bats, among others (Wu et al., 2020; Zhou et al., 2020). In 2020, the death toll for COVID-19 exceeded 1.7 million globally (Centers for Systems Science and Engineering, 2020; Dong et al., 2020), and early research has revealed significant and persistent damage to cells within the lungs from the virus, which may explain chronic symptoms for some individuals (Bussani et al., 2020). These examples illustrate the massive losses of life and impacts to human health associated with zoonoses at a global scale.

In addition to these health impacts, zoonoses also pose a major threat to the world economy (Cunningham et al., 2017). Findings suggest that the economic impacts of zoonoses reach into multiple sectors of the global economy, causing losses estimated in the billions of dollars by effecting services worldwide including agriculture, tourism, commerce, and transportation (Fonkwo, 2008). For instance, the cost of the global AIDs response for 2020 is estimated to be \$26 billion (UNAIDS, 2020). Other major outbreaks including SARS, Ebola, and H1N1 have cost economies worldwide a combined \$138 billion (Global Preparedness Monitoring Board, 2019). The COVID-19 pandemic is predicted to have a total cost of \$16 trillion when factoring in loss of human life, direct economic impacts, impacts to mental health, and long-term health impacts while assuming that the virus will be well contained by Fall 2021 (Cutler and Summers, 2020).

Beyond the severe consequences of zoonoses for humans, these diseases also present a direct threat to wildlife species and biodiversity on a global scale (Daszak et al., 2000; Corlett et al., 2020; Morand, 2020). For example, George et al. (2015) found that 47% of avian species in a sample of a quarter million birds tested positive for the zoonosis West Nile Virus, which caused significant mortality in species that failed to build immunity over time. Zoonoses that emerge from wildlife may transfer to humans and “spillover” back into susceptible wildlife populations, as evidenced by the transfer of the zoonotic parasite *Giardia* from humans to wildlife species such as beaver and muskoxen (Jenkins et al., 2013; Thompson, 2013). Given a lack of

immunity to COVID-19 within North American bats, spillover from humans into populations of bats poses a potential threat to bat conservation (Olival et al., 2020). Recently, COVID-19 has spilled over into populations of mink in Utah, United States, and Denmark, resulting in mass culling and heavy economic losses (Cahan, 2020; Munnink et al., 2020). Spillover of zoonoses also occurs from populations of wildlife to domesticated animals and vice-versa, often incentivizing the elimination of wild species that carry the disease (Nugent, 2011). For instance, Bison herds in Yellowstone National Park have been culled in order to prevent the spread of Brucellosis (*Brucella abortus*) to domestic livestock, thus negatively impacting bison conservation within the park (White et al., 2011). These are only a few of the many examples of zoonoses that simultaneously affect both humans and wildlife.

For all of these reasons, growing global efforts to research and improve science communication regarding zoonoses have increasingly focused on the One Health perspective (Zinsstag et al., 2020). One Health is a “collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment” (Centers for Disease Control, 2020). This perspective illuminates the interconnected nature of human, environmental, and animal health, and suggests that addressing zoonoses requires broad conservation policies that encourage human behavior change and designate protected areas for wildlife (Jenkins et al., 2015; Bonilla-Aldana et al., 2020).

Effective communication that influences risk perceptions of zoonoses and targets behavior change is a key element of the One Health approach (Decker et al., 2012), and the efficacy of such communication has been supported by prior research (Triezenberg et al., 2014; Lu et al., 2016). In one study focused on bovine tuberculosis (TB) in white-tailed deer (*Odocoileus virginianus*), persuasive communication materials mailed to hunters increased the perceived risk from TB, increased reported behavioral intentions to hunt the species, and increased the perception that other hunters were carrying out behaviors to combat TB (Triezenberg et al., 2014). Another study found that persuasive communications that conveyed the risk of rabies from bats, while also highlighting their ecological benefits, were able to influence intentions to adopt recommended rabies prevention measures without stigmatizing bats (Lu et al., 2016). Studies such as these are useful because effective wildlife communication can help members of the public understand risk, which in turn has been shown to influence support for wildlife disease management (Hanisch-Kirkbride et al., 2013). Such studies are also needed to avoid inciting bias against specific species, inspiring fear of natural areas, and eroding support for conservation (Decker et al., 2012; Buttke et al., 2015). For example, misinformed individuals who see bats as the cause of the COVID-19 pandemic may wish to enact retribution or withdraw support for bat conservation (MacFarlane and Rocha, 2020).

Cultural framing, or packaging information to appeal to an audience’s worldviews, influences risk perception of some environmental issues and the perceived validity of science

related to them (Kahan et al., 2008; Kahan et al., 2015). For example, with respect to climate change, a technocratic framing that emphasizes technological solutions and highlights the power of human ingenuity tends to resonate well with those who hold individualistic worldviews, whereas a regulatory framing that focuses on restrictions to markets and protections for the environment resonates well with those holding communitarian worldviews (Kahan et al., 2015). Political ideology operates similarly to worldviews, with both liberals and conservatives reacting negatively to scientific information that conflicts with their cultural worldviews. This dynamic is on display when predicting concern about genetically modified foods among liberals (Zimmerman and Eddens, 2018) and climate change skepticism among conservatives (Hamilton, 2015). Accounting for cultural worldviews, or political ideology as a more concrete manifestation of worldviews, appears to be crucial for effective communication about science topics. Cultural framing may therefore impact how people respond to communication about zoonotic diseases. For instance, framing that emphasized human responsibility for the emergence of Lyme disease and impacts of the disease in the near future created backlash among Republicans, who reported lower intentions to engage in pro-conservation behaviors after receiving the communication; yet, the same framing had no impacts on the conservation behavioral intentions of Democrats (Roh et al., 2015). Although the efficacy of One Health communication has been demonstrated (Lu et al., 2016; Lu et al., 2017), it is not clear how such messaging resonates or conflicts with individuals who hold different cultural worldviews or political ideologies. Our study used the COVID-19 content to explore answers to this question.

METHODS

Institutional Review Board (IRB) approval was obtained before commencing the study. We collected a nationally representative sample of 1,554 United States residents through a *Qualtrics XM* survey panel during August 2020. In the *Qualtrics XM* panel potential respondents from across the United States sign up to participate in online surveys through the *Qualtrics* website. Researchers set certain criteria for a sample (in our case, a representative sample of the United States) and *Qualtrics* invites respondents to participate who meet the criteria. *Qualtrics* continues to collect data until quotas set by the researchers are filled, at which time the researchers can download the data for analysis. We chose to use a *Qualtrics* panel as it allowed for demographic quotas and, when compared to other online panel providers, came closest to a national probability sample in terms of demographic and political representativeness (Boas et al., 2018). *Qualtrics* also allowed for rapid data collection—a critical need in a COVID-19-focused study. The panel for this study drew from a national pool (50 states and Puerto Rico) with demographic quotas for regions of the United States (South, West, Midwest, Northeast), race/ethnicity (White, Hispanic, Black, Asian), and age (18–34, 35–54, 55+). Quotas were also set for the different treatment groups to ensure equal responses across groups. Though

Qualtrics panels have no true response rate, as the respondents are paid to complete the survey, they do provide an “incidence rate” that measures the amount of potential respondents who were deemed ineligible for participation. In this case, this included those under the age of 18 and those who we had already met demographic quotas for, resulting in an incidence rate of 60% of the total potential respondents.

Several scales were adapted from prior literature or, where not previously established, generated by the authors for the purposes of this study (Table 1). The scale used to assess the perceived risk of COVID-19 was adapted from Kahan et al. (2015). The trust in science and skepticism toward science scales were also adapted from previous literature (Gauchat, 2011; Nadelson et al., 2014). Two scales measuring beliefs about COVID-19 origins and attitudes toward wildlife trade were developed by the authors for this study. The measure used to assess respondents’ perceptions of the validity of the hypothetical scientific study was adapted from Kahan et al. (2015). Reliabilities were assessed for each scale with the cutoff Cronbach’s alpha >0.70 (Nunnally, 1978).

Political ideology was assessed using a 5-point scale, adapted from Casola et al. (2020), ranging from strong conservative to strong liberal. We chose to use political ideology rather than the more abstract constructs sometimes employed in the cultural cognition framework (e.g. communitarian and individualist) for three key reasons. First, research suggests cultural cognition closely parallels political ideology (Wildavsky, 1987; Gastil et al., 2011) and may be a means for explaining why individuals with different political ideologies differ in their views on topics (van der Linden, 2016). Second, initial research suggests that political ideology is particularly salient for driving polarization of COVID-19 topics (e.g. Calvillo et al., 2020; Hart et al., 2020). Thus, political ideology has more empirical support as a driver of attitudes toward COVID-19 than other measures of cultural worldview. Third, political ideology is more concrete and widely recognizable than the abstract measures of cultural worldview, which facilitates application of results.

We used a two-channel science communication strategy to assess how message framing influenced perceptions of the validity of a study related to the origins of COVID-19 (Kahan et al., 2015). To this end, we followed the approach of Kahan et al. (2015) and developed two fictional, but factually accurate, articles with message frames that contained the same channel 1 and a different channel 2 communication. Channel 1 (the first four paragraphs, the exact same in each treatment) focused on providing empirical information relevant to zoonoses. Channel 2 (the remaining paragraphs, differing by treatment) focused on unique appeals to specific cultural values. We also adapted a third control article from Kahan et al. (2015) with no cultural framings or channeled communication. The first group received a technocratically framed article designed to appeal to individualistic values, “Early detection and elimination, not additional wildlife regulations, needed to fight diseases like COVID-19” (Figure 1). The structure of this article was loosely based on the geoengineering framed article present in Kahan et al. (2015), but focused instead on technical aspects of

TABLE 1 | Means, standard deviations, and Cronbach's Alpha for scale items ($n = 1,554$).

Scale and item Description	Mean	Sd	Cronbach's alpha
Trust in science	—	—	0.83
<i>To what extent do you agree with the following statements about science?^a</i>	—	—	—
TRUST1: Science and technology make life healthier, easier and more comfortable	5.51	1.28	—
TRUST2: Even if it brings no immediate benefits, scientific research is necessary and should be supported by the government	5.49	1.38	—
TRUST3: Overall, the benefits of scientific research have outweighed any harmful effects	5.02	1.50	—
TRUST4: Most scientists want to work on things that will make life better for the average person	5.42	1.35	—
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
TRUST5: We should trust the work of scientists	5.24	1.29	—
TRUST6: We should trust that scientists are being honest in their work	5.15	1.35	—
Skepticism toward science	—	—	0.76
<i>To what extent do you agree with the following statements about science?^a</i>	—	—	—
SKEP1: We depend too much on science and not enough on faith	4.17	1.95	—
SKEP2: Science makes our way of life change too fast	4.42	1.73	—
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
SKEP3: We cannot trust scientists because they are biased in their perspectives	3.46	1.70	—
SKEP4: We cannot trust scientists to consider ideas that contradict their own	3.76	1.69	—
Perceived risk from COVID-19 to human health and wellbeing	—	—	0.82
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
RISK1: Diseases people catch from wildlife are increasing	5.11	1.38	—
RISK2: Human activity is causing the threat of diseases people catch from wildlife to rise	5.34	1.37	—
RISK3: Unless steps are taken to counteract diseases people catch from wildlife, there will be bad consequences for humans	5.41	1.37	—
<i>On a scale of 0–10 with 0 being “no risk at all” and 10 meaning “extreme risk,”^a</i>	—	—	—
RISK4: How much risk would you say diseases people can catch from wildlife pose to human health, safety, and prosperity?	5.47	1.25	—
Belief in a COVID-19 wildlife origin	—	—	0.77
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
ORIG1: COVID-19 is a disease that originated in wild animals	4.20	1.97	—
ORIG2: Diseases such as COVID-19 can be prevented by changing the way people interact with wildlife	4.24	1.87	—
Attitudes toward restricting wildlife trade	—	—	0.89
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
TRD1: All commercial sales of wildlife products should be stopped	4.32	1.90	—
TRD2: All markets that sell live wild animals should be shut down	4.68	1.91	—
TRD3: All markets that sell carcasses or meat from wild animals should be shut down	4.58	1.94	—
TRD4: Wildlife products should not be transported between nations	5.08	1.80	—
Perceived validity of nature science study	—	—	0.61
<i>With 0 meaning “completely unconvincing” to 10 meaning “completely convincing”^a</i>	—	—	—
VALID1: In your view, how convincing was the Nature Science study on a scale of 0–10?	5.46	1.31	—
<i>To what extent do you disagree or agree with each of the following statements?^b</i>	—	—	—
VALID2: Computer models of diseases spread from wildlife are valid	4.78	1.41	—

^aRecorded to 7-pt Likert scale.^bLikert scale 1 = “strongly disagree” to 7 = “strongly agree”.

wildlife population management (Bosch et al., 2015; Grant et al., 2017). The second group received a regulatory framed article designed to appeal to communitarian values, “More Protected Areas for Wildlife and Stricter Regulations Needed to Fight Diseases like COVID-19” (Figure 2). This article’s structure was loosely based on the anti-pollution article in Kahan et al. (2015), but instead focused on restrictions for wildlife trade and expansion of wildlife refuges as encouraged by the One Health approach to managing wildlife disease like COVID-19 (Bonilla-Aldana et al., 2020). Following the model in Kahan et al. (2015), individuals in the third control group received an article about traffic signals that was free of any information about COVID-19 that would activate cultural values (Figure 3). We randomly assigned respondents to one of these three treatments.

After reading the randomly assigned framing article (technocratic, regulatory, or control), all respondents read an article excerpt from a fictional, but factually accurate, scientific journal (*Nature Science*) about COVID-19 and the relationship between humans and ecosystem health (Figure 4). This article included factual information from Bonilla-Aldana et al. (2020), Mackenzie and Smith, (2020), and Rothan and Byrareddy (2020) regarding the wildlife origin of COVID-19, the risk to human health and wellbeing associated with the disease, and the potential economic losses from zoonoses such as COVID-19. This article lacked ideological framing, and we sought to reduce the perception of cultural meanings by specifically focusing on descriptive wording in this article. To do this, we avoided words and phrases that would obviously evoke cultural meanings, as suggested by Kahan et al. (2015). Respondents

Scientists: Early detection and elimination, not additional wildlife regulations, needed to fight diseases like COVID-19

New study finds current wildlife management practices will not prevent future diseases

By Andrew Taylor
June 24th, 2020

WASHINGTON DC. Avoiding the worst effects of diseases that humans can catch from wildlife, such as COVID-19, will require a different approach, a group of expert scientists announced today. Countries should focus less on making new wildlife regulations and new protected areas for wildlife. Instead, new technologies that reduce the risk of wildlife giving humans diseases are needed.

The group, the American Academy of Wildlife Disease (AAWD), based this conclusion on a new study finding that the coronavirus (COVID-19) likely originated from a wildlife market in Wuhan, China, and that the threat of similar diseases emerging from wildlife markets and wildlife trade in the future is high.

The study was done by researchers from the Massachusetts Institute of Technology who were unaffiliated with AAWD and who published their findings earlier this year in the journal *Nature Science*.

“Before this study,” said AAWD spokesman Dr. Alan M. Williams of Harvard University, “people believed diseases such as COVID-19 could be detected and stopped before they spread, but this scientific study in *Nature Science* shows that current strategies for protecting people from wildlife diseases will not be enough.”

“Even with more rules at wildlife markets and more policing of wildlife trade,” Dr. Williams told reporters, “the *Nature Science* study shows that the future risk of people catching diseases from wildlife is high.”

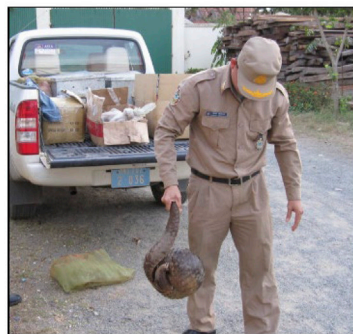
The AAWD report states that the *Nature Science* study “supports only one conclusion: more rules for wildlife trade and more protected areas for wildlife are wasteful strategies.” Instead, the report urges using technology to find diseases faster and remove wildlife that carry diseases.

“There are many technologies available to find and eliminate wildlife diseases,” said Dr. Alan Williams. “Trained professionals can find diseases within wildlife populations with the highest risk of spreading to humans. Then wildlife populations with the diseases can be removed.”

Developing these so-called “early detection” technologies, the AAWD report concludes, would not only be more effective than new rules and new protected areas for wildlife, but also spare consumers and businesses the economic costs associated with regulation of wildlife trade and lost opportunities for development on protected lands.

“Human beings have faced challenges from nature throughout history,” Williams told reporters at a press conference. “We’ve never accepted defeat - we’ve always overcome them with ingenuity.”

“Consider today’s high-yield farming methods, the miracles of modern medicine, and the breathtaking feats of urban engineering,” Williams stated. “Well, it’s time for us to innovate our way out of another jam.”



Technology-driven solutions for preventing wildlife diseases in humans. AAWD report proposes technological solutions to prevent future coronaviruses after study reports “a common exposure point for all of the infected individuals, the seafood market in Wuhan, China.” Professionals can test for coronaviruses in the field (left) and extract and analyze samples in the lab (right) in order to track and eliminate wildlife that carry diseases. (Credit: AAWD report “Fighting Diseases from Wildlife: Technology, Not Regulation, Needed to Prevent Outbreaks.”)

FIGURE 1 | Technocratic framing of COVID-19 science highlighting human ingenuity and technology as means to prevent and control the emergence and spread of zoonoses. Modeled after Kahan et al. (2015), information from Bosch et al. (2015) and Grant et al. (2017). Images obtained from Creative Commons. Left image: “Pangolin Rescue” by Wildlife Alliance is licensed under CC BY-SA 2.0. Right image: “Townsend’s big-eared bat” by USFWS Headquarters is licensed under CC BY 2.0.

Scientists: More Protected Areas for Wildlife and Stricter Regulations Needed to Fight Diseases like COVID-19

New study finds current wildlife management practices will likely be ineffective for preventing future diseases

By Andrew Taylor
June 24th, 2020

WASHINGTON DC. Avoiding the worst effects of diseases that humans can catch from wildlife, such as COVID-19, will require countries to expand the land area protected for wildlife and make new regulations, a group of expert scientists announced today.

The group, the American Academy of Wildlife Disease (AAWD), based this conclusion on a new study finding that the coronavirus (COVID-19) likely originated from a wildlife market in Wuhan, China, and that the threat of similar diseases emerging from wildlife markets and wildlife trade in the future is high.

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“Before this study,” said AAWD spokesman Dr. Alan M. Williams of Harvard University, “people believed diseases such as COVID-19 could be detected and stopped before they spread, but this scientific study in *Nature Science* shows that current strategies for protecting people from wildlife diseases will not be enough.”

“Even with more rules at wildlife markets and more policing of wildlife trade,” Dr. Williams told reporters, “the *Nature Science* study shows that the future risk of people catching diseases from wildlife is high.”

The AAWD report states that the *Nature Science* study “supports only one conclusion: the health and protection of wildlife is linked to the health of human beings.” As a result, “the overall area of protected land for wildlife and the number of regulations on wildlife trade will need to increase a lot,” the AAWD report concludes.

“World governments have a wide range of wildlife management tools at their command - including using tax money to protect land for wildlife, restricting wildlife trade, and limiting human activity in these protected areas,” said Dr. Williams. “It’s time to use them,” he said.

Industrialized nations such as the United States and Great Britain have so far opposed these policies needed to prevent humans from catching diseases from wildlife because new rules and new protected land might hurt businesses and consumers. Creating new protected areas for wildlife and adopting stricter regulations as suggested by the AAWD would impose large costs, the report acknowledged.

“Yes, we will all need to make sacrifices,” stated Williams in a press conference announcing the AAGS report. “Yet we are in this mess precisely because the residents of industrialized countries have, for decades, insisted on developing land and harvesting wildlife to achieve a standard of living that exceeds what the natural environment can support.” Williams told reporters in Washington, D.C.



Image removed for copyright purposes. The image was of a pangolin emerging from a cage.¹

Protecting wildlife may lower risk of disease transmission to humans. A recent study suggests that wildlife markets and illegal wildlife trade create “hotspots” for diseases that people catch from wildlife, like COVID-19. The AAWD has called for stricter regulations on wildlife trade as well as more protected areas to help wildlife and improve the health of wildlife.

FIGURE2 | Regulatory framing of COVID-19 science highlighting the need for regulations and expansions of protected areas for wildlife to prevent the emergence and spread of zoonoses. Modeled after Kahan et al. (2015), information from Bonilla-Aldana et al. (2020). ¹Link to removed image: <https://www.gettyimages.com/detail/news-photo/malayan-pangolin-is-seen-out-of-its-cage-after-being-news-photo/51341736?adppopup=true>

Traffic Signal Funds Required Developers Must Put up Surety Bond

By Jeffery Cohen
Broomfield County Star June 15, 2020

A new Broomfield County policy will ensure that the next time a community needs a new traffic light to handle traffic associated with a commercial development, it will have the funds necessary to pay for it.

Developers who want to begin work on a new subdivision will be required to put up a surety bond, probably as much as \$300,000, said Dorothy Doyle, the county's traffic division director. Traffic signals range in price from \$60,000 for those strung on wires to \$300,000 for a sturdier mast arm signal.

The impetus for the requirement comes from six recent cases in which traffic signals ended up being needed at communities where the developer had finished building, or in which the county had not initially heard concerns about a light, Doyle said.

The county will be able to hold the surety well after the subdivision is built, Doyle said, adding that the developer will be required to notify the county as it nears completion.

"We've always required developers to defray costs associated with the impact of their projects on local traffic, so this is nothing out of the ordinary," Doyle said.

Kevin Bain, President of GL Homes, Inc., the largest developer in the county, said many of his company's developments qualify for a signal anyway, adding that it's an appropriate issue for the county to address.

"It's a safety issue for our residents," Bain said. "We don't have an issue whatsoever with posting the surety."

Harry Halman, chairman of the Broomfield Chamber of Commerce, said the new surety policy makes sense.

"I think that the new requirements of anticipating the need for a traffic light are very valid, because inadequate traffic control is likely to discourage shopping downtown," said Halman.



Traffic signal bond policy adopted. Kevin Bain, President of GL Homes, Inc., (left) makes a statement at Broomfield County Safety Commission meeting on surety bond policy. The Commission approved a policy that would require developers to post a bond to cover the cost of installing traffic lights (right) at development sites after construction is concluded. (Credit: Harry Stevens.)

FIGURE 3 | Control article about funding for traffic lights free of cultural framing. Adapted from Kahan et al. (2015).

then answered questions about the perceived validity of the *Nature Science* article.

Analysis

First, we assessed the reliability of all study variables using the criteria of Cronbach's Alpha >0.70 (Nunnally, 1978). Next, we employed six one-way ANOVAs to test for differences in trust in

science (H1), skepticism toward science (H2), perceived risk of COVID-19 to human health and wellbeing (H3), beliefs in the wildlife origin of COVID-19 (H4), attitudes toward wildlife trade (H5), and perceived validity of the *Nature Science* article based on political ideology (conservative, liberal, or moderate). For each ANOVA, we conducted a post-hoc Tukey's multiple comparison tests to test for significant mean differences between each group.

Excerpt from: “COVID-19: The Relationship between Human and Environmental Health,” *Nature Science*, Vol. 72 pp. 516-32 (2020):

Over the past two decades we have seen the dangers of coronaviruses that are constantly evolving, resulting in deadly outbreaks that pose global public health threats. COVID-19 emerged in Wuhan, China, at the end of 2019, resulting in a quickly rising death toll around the world.

Initial studies suggest a common starting point for all of the infections: a seafood market in Wuhan, China. The restaurants of this market are famous for serving many types of wildlife for people to eat.

This seafood market is an example of a wet-market that sells birds, bats, snakes, rodents and other wild animals. Such wet-markets are ideal places for novel viruses to jump from wildlife to humans and create new human diseases.

Zoonotic diseases—those that pass from animals to humans—make up more than three-quarters of human diseases. And, 60% of zoonotic diseases come from wild animals. Notably, human activities, such as trade in wildlife, large-scale deforestation, and conversion of land for agriculture are increasing the risk of zoonotic diseases.

It is therefore important to learn what conditions allow diseases to jump from wildlife to people, and where wild animals are likely to have dangerous diseases. This should lead to new approaches for identifying diseases in wild animals, predicting how dangerous the diseases are, and learning how diseases move from wildlife to people.

The COVID-19 outbreak is the third instance where a coronavirus has crossed from wild animals to humans after the occurrence of SARS, and MERS outbreaks. The possibility of a fourth outbreak can be expected in the future, possibly from another human-wildlife interaction just like the wet-market in Wuhan.

As deaths from the COVID-19 pandemic grow globally, one thing is clear: **as human interaction with wildlife continues to increase, we will see more outbreaks like COVID-19, and the next pandemic could be even more deadly and costly.**

FIGURE 4 | Factually accurate article from a fictional ‘Nature Science’ academic journal highlighting the science surrounding COVID-19 without cultural framing. Generated by authors with information from Bonilla-Aldana et al. (2020), Mackenzie and Smith (2020), and Rothan and Byrareddy (2020).

Then, we tested message framing effects using multiple linear regression to predict the perceived validity of the *Nature Science* article based on the interaction of experimental treatments and political ideology (H6-7). Model 1 examined the main effect of framing type (technocratic, regulatory, or control) on perceived study validity of the *Nature Science* article. Model 2 added political ideology as a covariate. Political ideology was converted into two binary variables (liberal and moderate), with conservatives as the reference group. Model 3 included interactions between treatment and each dummy variable to determine if the impact of the experimental treatment groups varied depending on a respondent’s political ideology. In each model, we controlled for gender (1 = male, 2 = female) and education level [1 = “some high school,” 2 = “high school diploma

or GED,” 3 = “Associate’s or Bachelor’s degree (BA, BS, etc.),” and 4 = “Graduate or professional degree (MS, MBA, MD, JD, PhD, etc.).”].

RESULTS

The trust in science ($\alpha = 0.83$), science skepticism ($\alpha = 0.76$), perceived risk of COVID-19 ($\alpha = 0.82$), belief in a COVID-19 wildlife origin ($\alpha = 0.77$), and attitudes toward restricting wildlife trade ($\alpha = 0.89$) scales all produced acceptable reliability (Table 1). The initial 4-item scale used to measure perceived study validity initially produced low reliability ($\alpha = 0.45$). The removal of two items (“The scientists who did the study were

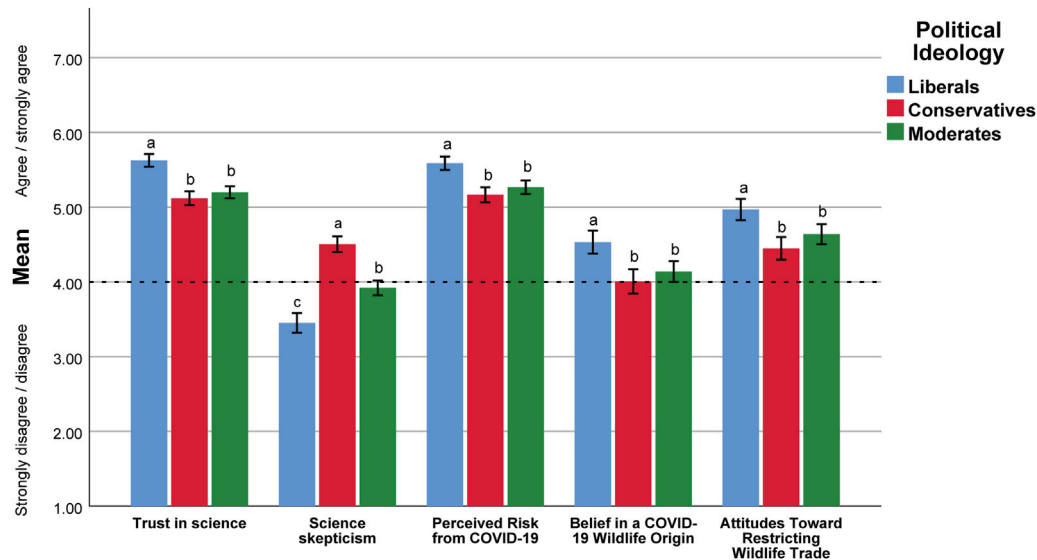


FIGURE 5 | Means with 95% confidence intervals for study variables regarding attitudes toward science and the COVID-19 pandemic grouped by political ideology. Significant differences ($p < 0.01$) revealed by a post-hoc Tukey's Test are denoted by letters above each bar. Groups sharing the same letter are not significantly different from each other. Measured on a 7 pt Likert scale where 1 = 'strongly disagree' and 7 = 'strongly agree'. The dashed line through point 4 on the y-axis represents the 'neutral' choice within the 7 pt Likert Scale.

biased" and "More studies must be done before policy-makers rely on the findings of the *Nature Science* study") improved reliability for the final two-item scale ($\alpha = 0.61$) measuring perceived study validity (of the *Nature Science* article).

H1 was partially supported, as liberals reported higher trust in science than conservatives and moderates, but we did not detect a difference between moderates and conservatives [$F(2) = 37.48$, $p < 0.001$] (Figure 5). Similarly, H2 was partially supported, as all three groups differed significantly in their views on skepticism toward science [$F(2) = 82.19$, $p < 0.001$]. Conservatives expressed the most skepticism toward science, and liberals expressed the least (Figure 5). H3 was partially supported by the ANOVA for political ideology and perceived risk of COVID-19 [$F(2) = 22.60$, $p < 0.001$]. Liberals perceived more risk than both moderates and conservatives, who did not differ significantly in their views of risk (Figure 5). H4 was also partially supported by the ANOVA for COVID-19 origins [$F(2) = 12.44$, $p < 0.001$]. Liberals believed in a wildlife origin of COVID-19 more than both moderates and conservatives, who did not differ significantly (Figure 5). H5 was partially supported by the ANOVA for political ideology and wildlife trade [$F(2) = 12.07$, $p < 0.001$]. Liberals were more likely to support restrictions on wildlife trade than both conservatives and moderates, who did not differ significantly (Figure 5).

Liberals differed significantly from both conservatives and moderates in their perceived validity of the *Nature Science* study, and conservatives did not differ significantly from moderates [$F(2) = 23.56$, $p < 0.001$]. Mean perceived validity of the *Nature Science* article was highest among liberals, followed by moderates and then conservatives (Figure 5). The results of the baseline regression model, model 1, did not detect direct effects of the technocratic ($\beta = -0.06$, $p = 0.43$) or regulatory framing ($\beta = 0.04$, $p = 0.59$) on perceived study validity, and

TABLE 2 | Means and standard deviations for the perceived study validity variable by message framing treatment group and political ideology.

Treatment	Political ideology	Mean	SD	N
Technocratic framing	Conservatives	5.00	1.38	169
	Liberals	5.19	1.08	163
	Moderates	5.01	0.99	191
	Total	5.06	1.16	523
Regulatory framing	Conservatives	4.87	1.18	160
	Liberals	5.50	1.10	173
	Moderates	5.16	1.10	176
	Total	5.18	1.15	509
Control	Conservatives	4.90	1.19	169
	Liberals	5.50	1.13	161
	Moderates	4.98	1.07	192
	Total	5.12	1.16	522

accounted for 4% of the variation in perceived study validity ($R^2 = 0.040$). Mean values showed that, across all political groups, individuals exposed to the regulatory framing perceived only slightly higher study validity than individuals exposed to the control or technocratic group (Table 2). Model 2 included the dummy variables for political ideology without any interactions and accounted for 7.2% of the variation in perceived validity of the *Nature Science* study ($R^2 = 0.072$). Results revealed that liberals ($\beta = 0.52$, $p < 0.001$) and moderates ($\beta = 0.20$, $p = 0.003$) found the *Nature Science* study more valid than conservatives. Model 3 examined the interaction between political ideology and each framing treatment, and accounted for approximately 7.6% of the variation in perceived study validity ($R^2 = 0.076$) (Table 3). A significant interaction between the technocratic framing and the liberal dummy

TABLE 3 | Multiple regression modeling the effects of political ideology and treatment group on perceived study validity of the *Nature Science* article.

Effect	Model 1	Model 2	Model 3
Intercept	4.72 (28.61)***	4.58 (27.38)***	4.55 (25.75)***
Gender	-0.17 (-2.82)**	-0.22 (-3.71)***	-0.21 (-3.53)***
Education	0.23 (6.23)***	0.22 (6.03)***	0.22 (6.03)***
Technocratic	-0.06 (-0.78)	-0.06 (-0.81)	0.07 (0.58)
Regulatory	0.04 (0.55)	0.03 (0.36)	-0.03 (-0.27)
Liberal	—	0.52 (7.27)***	0.63 (5.14)***
Moderate	—	0.20 (2.94)**	0.17 (1.45)
Technocratic x liberal	—	—	-0.36 (-2.08)*
Regulatory x liberal	—	—	0.02 (0.11)
Technocratic x moderate	—	—	-0.04 (-0.23)
Regulatory x moderate	—	—	0.14 (0.82)
R ²	0.040	0.072	0.076

n = 1,554. The dependent variable is study validity. Regression weights are standardized beta coefficients with t-values listed in parentheses.

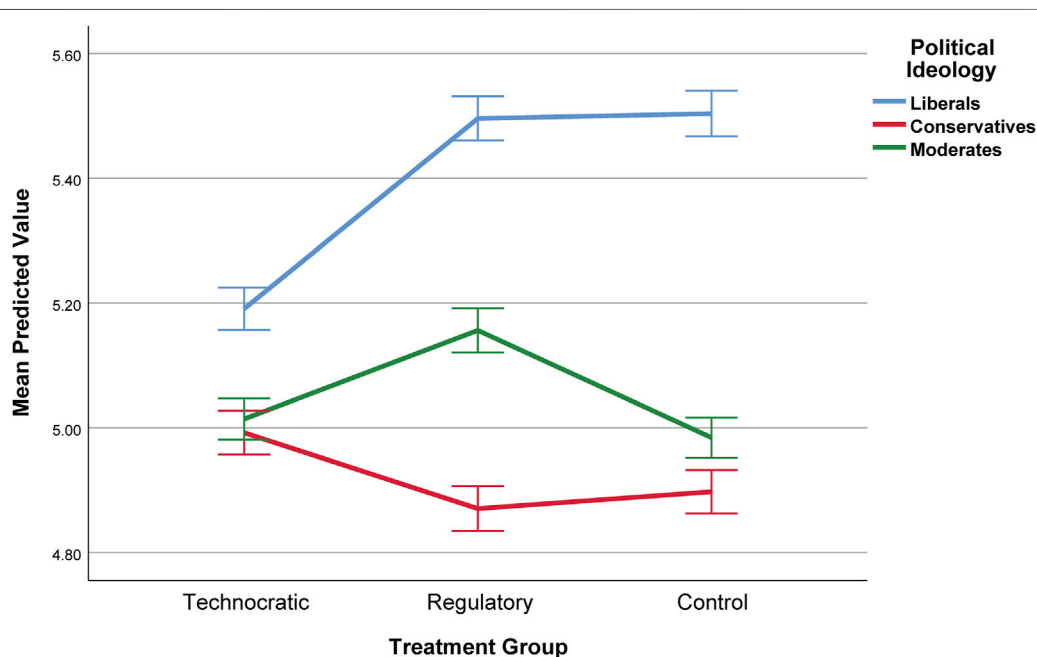
*p < 0.05, **p < 0.01, ***p < 0.001.

variable ($\beta = -0.36, p = 0.05$) partially supported H6. The plot of the interaction effect suggests that liberals who received the technocratic framing found the study less valid than the control group, and conservatives who received the technocratic framing found the study slightly more valid than the control group (Figure 6). We did not detect a significant interaction between the moderate dummy variable and the technocratic framing ($\beta = -0.04, p = 0.82$). This is also reflected in Figure 6, as moderates did not appear to differ in their perceived study validity between the group that received the technocratic framing and the one that received the control. H7 was not supported, as we did not detect a significant interaction

effect on perceived study validity for the regulatory framing for the liberal dummy variable ($\beta = 0.02, p = 0.92$) or the moderate dummy variable ($\beta = 0.14, p = 0.41$).

DISCUSSION

Our results suggest political ideologies predict divergent views of scientific evidence (in general) and evidence about surrounding the wildlife origins of COVID-19 (specifically) in the United States. The patterns we observed build on prior research. Namely, liberals trusted science more and were less skeptical of science than both conservatives and moderates. This finding aligns with the trend of conservatives expressing less trust in science as science becomes more politicized over time (Gauchat, 2012; Nisbet et al., 2015; Funk et al., 2019). Liberals also perceived more risk from COVID-19 than conservatives and moderates, which aligns with another study suggesting conservatism was associated with less perceived individual vulnerability to COVID-19 and lower perceived severity of the pandemic (Calvillo et al., 2020). Our study also elucidates how political ideology influences topics relevant to the novel coronavirus by showing that liberals, on average, reported believing in a COVID-19 wildlife origin and supporting restrictions on wildlife trade to combat zoonotic disease more than conservatives and moderates. These results align with and reinforce initial reports that conservatives are more likely to believe conspiracy theories that COVID-19 was produced in a laboratory setting (Jiang et al., 2020; Romer and Jamieson, 2020). Together, these findings are crucial for assisting policymaking in the era of COVID-19, as policy development surrounding the

**FIGURE 6 |** Predicted means based on OLS regression model 3 with 95% confidence interval error bars for perceived validity of the *Nature Science* study, grouped by political ideology and treatment group.

disease will hinge on trust in scientific expertise and decision-makers advocating for disease management (Cairney and Wellstead, 2020). They also underscore the importance of developing strategies for effectively communicating in a way that increases the perceived validity of science surrounding the pandemic, especially when politicians are inclined to use uncertainty and misinformation that appeals to political ideologies to reduce support for science-based policies (Cinelli et al., 2020; Kreps and Kriner, 2020).

Our results also contribute to research on communicating about zoonotic disease through the One Health lens by highlighting how cultural cognitions shape public consumption of related science (Kahan et al., 2011). Our investigation of different message frames related to the zoonotic origins of COVID-19 yielded two key conclusions. First, strategic framing based on cultural worldviews likely shapes how people in the United States respond to COVID-19 science, but with relatively small impacts. For instance, technocratic framing was only slightly effective in increasing perceived study validity among those with conservative ideology (as compared to conservatives in the control group). However, we did detect a significant drop in perceived study validity for liberals who received the technocratic framing as compared to those in the control group. These results are comparable to those of a study employing cultural worldviews to understand perceptions of climate change. Kahan et al. (2015) found that the technocratic framing (a framing that highlighted a geoengineering approach to climate change) increased perceived study validity among those with individualistic worldviews and decreased it among communitarians. In another study, cultural worldview influenced perceived benefits and risk of nanotechnology, with communitarians less likely than individualists to recognize the benefits of nanotechnology as compared to the risks (Kahan et al., 2008). Similarly, our results suggest that cultural appeals rooted in technological framings may negatively influence perceptions of COVID-related messaging for those with a liberal ideology. Liberals' apparent distrust of the technocratically framed article may be explained by the cultural cognition thesis, which posits that those who hold communitarian values, including political liberals, are more concerned about technological risks than more conservative people (Douglas and Wildavsky, 1983; Kahan et al., 2008). This idea has been supported by studies in the domains of nanotechnology (Kahan et al., 2008), nuclear power (Peters and Slovic, 1996), and genetically modified foods (Finucane, 2002). Thus those with liberal ideology are likely skeptical of the safety and efficacy of technological solutions to wildlife diseases due to cultural cognition. If issues surrounding science continue to be politicized in the coming years, or grow even more politicized as some predict (Gauchat, 2012; Funk et al., 2019), an enhanced understanding of the effects of cultural cognition on information processing will be crucial to improve the efficacy of science communication and inform research and practice.

The absence of an interaction between regulatory framing and political identity in the context of COVID-19 should be interpreted with caution. As implied above, among conservatives, regulatory framing may not differentially impede trust or trigger distrust in the science surrounding zoonoses in the way that it does for potentially more politically charged domains such as climate change (Kahan et al., 2015). For liberals, the regulatory framing of the study treatment might not have adequately activated communitarian values, thereby generating a negligible response. The novelty of the COVID-19 pandemic may play a role here as well, as members of the public may be less inclined to acknowledge direct links between human health and environmental conservation. New message frames that incorporate more diverse aspects of One Health communication, including those that highlight the importance of habitat conservation as a disease mitigation strategy (Deem et al., 2001), might be more effective at influencing the behavior of liberal audiences.

Our results suggest the regulatory and technocratic framings had little to no effect among self-identified moderates. This may be a result of the message content or a result of the political ideology of those in the moderate group. Unlike politicized and polarized topics such as climate change, zoonoses may be a neutral subject among moderates. Studies have also suggested that the moderate label is a poor indicator of politically central ideals. Instead, some researchers argue the self-reported moderate label is a result of respondents attempting to describe their preferences on a single scale, when in reality they prefer a mix of policies that span the political spectrum (Ahler and Broockman, 2014). This conglomeration of diverse views may drown out differences that exist within the group. Collectively, these findings regarding the influence of cultural cognition and political ideology suggest that science communicators should carefully consider the political leanings of target audiences when framing information regarding zoonotic diseases, especially within the context of the COVID-19 pandemic.

Another aspect of our study that should be noted was that, despite statistical significance, the interaction term in our model displayed low predictive power. This leads to our second conclusion that although politically motivated message framing is important when communicating about science topics, such framing might be less relevant in the case of zoonotic diseases. While strategic framing is undoubtedly influential, direct and descriptive zoonotic disease communication frames that intentionally avoid activation of cultural cognitions and values may ultimately be the safest (i.e., less polarizing and contentious) approach to influencing the beliefs and behaviors of politically diverse audiences. One possible explanation for the relatively small influence of framing and political ideology in our study is that discussions of the zoonotic origins of COVID-19 were quickly marginalized when the media began to focus myopically on polarizing issues (Hart et al., 2020) such as mask wearing (Utych, 2020) and vaccines (Puri et al., 2020).

Limitations and Future Research

One of the primary limitations associated with this study was the possibility of omitted variable bias. Given the relatively low explanatory power of our final model, there are likely other key variables contributing to the perceived validity of the *Nature Science* article that were not included. For example, profession be relevant if individuals who are trained as scientists or health professionals are more likely to trust science (Krause et al., 2019), and exposure to COVID-19 could be relevant if those who have experienced the disease are more likely to believe the science of it. Initial results suggest that the lived experience of nurses during COVID-19 influenced their mental state by inducing fear, stress, and anxiety (Karimi et al., 2020). Furthermore, obese individuals reported experiencing fear and anxiety because of the pandemic and their status as a vulnerable population (Grannell et al., 2020). Future research should seek to illuminate how the lived experience of the COVID-19 virus, especially for those strongly affected by it or vulnerable to it, influences cultural cognitions.

Another limitation of this study is the use of a sample of United States respondents. The generalizability of these results cannot be assumed for an international audience. Future research should examine how cultural worldviews influence science communication about zoonoses in other countries beyond the United States where the split between political groups may be different. Specifically, liberal and conservative ideologies do not parallel political parties in other international contexts as closely as they do in the United States, where they have become seemingly inseparable (Pew Research Center, 2017). For example, eight distinct political groups across a wide ideological spectrum held seats in the European Parliament in 2019 (Pew Research Center, 2019). Nevertheless, various forms of political polarization and conflicting ideologies abound globally and consistently present challenges for effective communication (Carothers and O'Donohue, 2019). This underscores the importance of understanding cultural cognitions, however they manifest, to inform strategic communication and messaging around contentious issues such as COVID-19.

Another notable limitation is that our two-item scale for “perceived validity” of our fictional *Nature Science* communication failed to produce a reliability coefficient above the recommended cutoff of $\alpha = 0.70$ (Nunnally, 1978). The two items we removed from the scale were reverse-coded and later recoded to match the positive wording of the other items. Scales using reverse-coded items reduce acquiescence bias, but also reduce reliability scores (Weems and Onwuegbuzie, 2001; Boley et al., 2020). The use of scale measures that were all positively worded may improve scale reliability in the future. Additionally, we closely adapted our fictional message frames from Kahan et al. (2015), which could be problematic if COVID-19 requires a drastically different approach to communication compared to other issues such as climate change. Specifically, the

cultural meanings associated with COVID-19, and the mechanisms for best evoking them, are not yet well understood.

Another possible limitation for this study is self-report accuracy. While the wordings and questions were designed to be as clear as possible, some individuals might have found some questions or concepts confusing and responded inaccurately. Social desirability bias could come into play for questions regarding trust in science, assuming the respondent considers trust in science to be a socially desirable trait. However, social desirability bias may be less prominent in web (vs. face-to-face) surveys (Heerwegh, 2009). Another limitation is the use of online respondents, who are sometimes considered a less reliable source of data. However, due to the need for safe and rapid data collection, an online panel was the best option for this study as it comes close to national probability samples in terms of representativeness (Boas et al., 2018).

Future research should explore additional variables that may impact the perception of validity of scientific studies and explore the efficacy of alternative communication framings that might not be politically motivated. Gain and loss framing (Tversky and Kahneman, 1981), which can be influential in a conservation context (Jacobson et al., 2019), could be especially relevant to the COVID-19 pandemic, where the gains (lockdowns ending sooner, businesses reopening), and losses (deaths of loved ones, economic impacts) of behaviors to reduce the impact of the virus may be particularly salient. Future studies could also examine how the impacts of framing change over time, and how the efficacy of framings might differ as a function of the severity of the pandemic.

Finally, the fact that political ideology did not contribute to a large amount of variance in our model may be an artifact of the novelty and newfound salience of zoonoses in the domain of public science communication. Whereas media coverage of the origins of COVID-19 cast a relatively new spotlight on zoonotic disease, public and highly politicized debates about climate change have been simmering in the media for decades (Brulle et al., 2012). For many issues (e.g., climate change), confirmation bias compels individuals to process scientific information in ways that align with culturally congruent worldviews (Kahan et al., 2015). For respondents who have little previous experience with the concept of zoonoses, however, there may be no (or few) preexisting beliefs to confirm. Strategic communication in this context might be even more effective because heuristics that often bias interpretation of information are absent (Akin and Landrum, 2017). Disease management communication would benefit from future research examining how the United States news media, social media, and misinformation interact with cultural cognitions to influence perceptions of zoonotic disease.

Conclusions

Our results reinforce that wildlife management agencies and conservation organizations operate in an increasingly complex social and political environment, where they must consider nuanced values and worldviews in developing and communicating policy and management decisions (Manfredo

et al., 2018). Furthermore, wildlife management is increasingly connected to broader issues and debates, presenting both potential opportunities and pitfalls. Given that zoonotic disease does not appear to be as controversial as other topics such as climate change, there may be space for wildlife agencies to proactively communicate about positive actions they are taking to help prevent occurrence and spread. For example, the United States Fish and Wildlife Service examines international shipments at ports across the country to prevent illegal transportation of animals and plants, which can help prevent the spread of wildlife diseases (U.S. Fish and Wildlife Service, 2019). Messaging that highlights these types of actions could align well with One Health communication initiatives and help wildlife management agencies proactively demonstrate the wide range of benefits that conservation can provide (Kellert et al., 2017). Effective science communication might also influence individual action to prevent the rise of zoonoses, as human interaction with wildlife is a key emergence factor (Alexander and McNutt, 2010). Inspired by One Health, interventions might involve partnerships between wildlife management (e.g., USFWS) and public health agencies (e.g., CDC) to provide proactive messaging about strategies for preventing zoonotic disease, such as keeping distances from wildlife and discouraging the purchasing of wildlife pets that may carry diseases (Chomel et al., 2007).

Our findings also highlight the importance of deploying effective communication framing that takes into account individuals' cultural values and political ideologies, especially as it pertains to topics such as zoonotic disease and politicized issues such as COVID-19. Emerging framings surrounding the risk of zoonoses that emphasize regulation, including the One Health framing, have the potential to generate backlash with conservatives (Wildavsky, 1987; Kahan et al., 2008; Kahan et al., 2015), though we did not detect this effect in the present study. In particular, regulations on wildlife trade and movements to expand protected areas to minimize the threat of zoonoses, though promising from a One Health perspective (Jenkins et al., 2015; Bonilla-Aldana et al., 2020), may be met with resistance among groups with individualistic values (Kahan et al., 2011). Our results highlight a potential to improve the efficacy of message frames directed at conservative audiences by focusing instead on feats of human ingenuity used to manage wildlife disease. Content in this messaging might include disease tracing, culling of diseased animals, and vaccination of wildlife populations (Bosch et al., 2015; Grant et al., 2017), or just a purely descriptive communication of the science of wildlife disease management. However, future research is needed to clarify how conservatives respond to different forms of regulatory framing in the context of COVID-19 and how this might change over time. Some wildlife management agencies may already be experiencing a backlash against policies and actions that seek to broaden conservation agendas beyond a historic focus on game species (Manfredo et al., 2017). In these cases, strategic framing may have the potential to influence conservatives' perceived validity of the science, which may enhance support for policy measures taken to prevent zoonotic diseases from emerging and spreading (Hanisch-Kirkbride et al., 2013).

On the other hand, technocratic solutions rooted in human ingenuity are not the only factors needed to effectively prevent the emergence and spread of zoonoses (Langwig et al., 2015). In fact, overemphasis on these approaches might be unpalatable to those with liberal and communitarian ideologies. Therefore, communication aimed at liberal audiences might focus on broader conservation goals while avoiding discussing tactics such as culling populations of threatened or endangered wildlife (Nugent, 2011; White et al., 2011; van Herten et al., 2019). Ultimately, a combination of these approaches is likely needed to effectively connect with different audiences and reduce the threat of zoonotic global outbreaks such as COVID-19 (Bosch et al., 2015; Cunningham et al., 2017; Grant et al., 2017). Such dilemmas highlight the growing importance of risk communication surrounding zoonotic disease and the need for strategic messaging to target distinct populations in order to achieve collective management goals and reduce the impacts of future pandemics on human health and environmental health.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because IRB restricts the distribution of data related to human subjects. Requests to access the datasets should be directed to Justin Beall, jmbeall@ncsu.edu.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by North Carolina State University Institutional Review Board for the Use of Human Subjects in Research. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

JB contributed much of the writing for this publication, performed the analysis, and helped design the survey instrument. WC contributed to the analysis and development of the survey instrument. He also helped with comments and direct contributions to the writing. MP took the lead on the design of the study and contributed significantly to the writing of the manuscript. LL was also heavily involved with study design and the writing of the manuscript. He also helped with analysis. WC contributed heavily to the portion of the discussion surrounding practical implications of our study and gave feedback to survey design. ES contributed feedback during the development of the survey and offered both comments and direct contributions during the writing process. KS contributed feedback during the development of the survey and offered both comments and direct contributions during the writing process. SJ

contributed feedback during the development of the survey, helped with the survey distribution process, and provided comments, direct contributions, and edits during the writing process.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2021.645692/full#supplementary-material>

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Big COVID, Red State: The Value of Over-Communication in a Public Health Crisis

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This Community Case Study examines the challenges of communicating about the COVID-19 crisis in a politically conservative American state, Idaho. The study presents an analysis of one local expert's communication strategies in the face of significant partisanship, threats of violence, and widespread refusal to comply with recommended public health behaviors. Findings suggest that consistent, cross-platform communication that emphasizes personalized recommendations and advice, transparency, and humility, are key strategies in a fractured information environment. However, while micro-level communication strategies are important, more must be done to help Americans regain trust in institutions, expertise, and information at a macro-level.

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INTRODUCTION

The COVID-19 pandemic's trajectory in the United States has created a number of opportunities to study crisis communication strategies, and especially how scientists, public health experts, and other professionals communicate during a public health crisis. The American context also allows us to analyze what constitutes effective crisis communication in a deeply polarized political environment characterized by mistrust in authority and institutions. Under the Trump administration, there was a lack of consistent pandemic leadership and management at the federal level, thus devolving authority to decision-makers at state and local levels, but without adequate support and guidance. This created a patchwork response, leading to rolling spikes in infection rates, closures of schools and businesses, and hundreds of thousands of deaths across the country. The pandemic itself has been deeply politicized; as a result, political affiliation often correlates with public health beliefs, attitudes, and behaviors (Shepherd et al., 2020). To make matters worse, social media regimes and leaders, including President Trump himself, circulated mis- and disinformation with alarming speed and in a polarizing manner (Evanega et al., 2020; Roosenbeek et al., 2020; Su, 2021).

Given this context, even skilled crisis communicators have struggled to “break through” to the public in an effective, prolonged, and non-partisan way. In fact, as communication scholars have argued, even in the best of times there is no one “public” communicators can target; rather, there are a variety of publics, and those publics may differ in their orientations toward politics, science, the media, the value of democratic norms and principles, and so on (e.g., see Metag and Schäfer, 2018). Audiences may also develop knowledge and beliefs about scientific issues based on complex media and communication “ecologies” and networks (Walter et al., 2018). Such effects are further exacerbated in a crisis, where fear and distrust are heightened. In turn, large-scale behavior change proved elusive, “COVID-fatigue” set in, and by late October 2020, the Trump White House itself admitted that it was no longer trying to actively stop the spread of the virus (McCaskill, 2020).

Given this context, it is unsurprising that no one spokesperson or organization was able to effectively communicate across the political spectrum on the pandemic during its first year. By the end of 2020, spokespeople who were prominent early on in the pandemic had been largely sidelined by President Trump. Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases and member of the Trump Administration's Coronavirus Task Force—who has served as the Director of the National Institute of Allergy and Infectious Diseases since 1984—is considered by most public health experts to be a trusted source of information on COVID. Fauci's public profile has been fractured along political lines, however, largely because public views on the pandemic itself are partisan, and because science itself may be more or less suspect depending on one's political orientation (Barry et al., 2020; Funk et al., 2020; Mordecai and Connaughton, 2020). Fauci is trusted primarily by those on the left of the political spectrum, but is considered highly suspect to many on the right (Samuels and Chalfant, 2020; Hamel et al., 2020; Miller and Colvin, 2020; Specter 2020).

Fauci's case is instructive, and points to the many ways in which President Trump's handling of the pandemic—including his approach to crisis communication and his posture toward scientific expertise—was both unethical and counterproductive. The Fauci case also points to the challenges of attempting to engage in effective crisis communication in a deeply fractured political environment. Recommended communication practices may be less effective when audiences do not share political or scientific realities and trust in institutions is not just low but being actively undermined by bad actors. We can see this same dynamic occurring at the local level, which is the focus of this community case study.

Because most action on COVID has devolved to the state level in the absence of federal action and leadership, it is useful to explore what COVID crisis communication can look like at local scales. This case study analyzes the communication strategies of a local science communicator, Dr. David Pate, in a deeply conservative (red) state—Idaho—in order to articulate effective strategies for sustained engagement at the local level, as well as to identify the limits of those strategies under conditions of extreme political polarization. Dr. Pate has emerged as one figure (though not the only one) functioning as the local equivalent of Dr. Fauci; he provides guidance for local publics who are confused, angry, and frightened about the pandemic's management and impacts, and is a favored expert of local journalists and others seeking expertise on the pandemic. But as is the case with Dr. Fauci, it is unlikely that Pate's approaches have done much to reach those on the far-right, whose voices often dominate Idaho politics. This is because the local context and its pandemic discourses have been deeply impacted by the national response and Presidential discourse.

Below, I provide some context describing how the pandemic has unfolded in Idaho, as well as Dr. Pate's role as a public health leader and communicator. I then suggest a framework for practitioners seeking to be more effective with science and crisis communication during a public health crisis, drawing on Dr. Pate's strategies, some of which are also supported by recommendations from crisis, risk, health, and science

communication literatures. I conclude the paper by discussing the limitations of focusing only on these strategies given the context of extreme hyper-partisanship and misinformation; this context limits how effective any one communicator can be. The Case Study draws on an interview I conducted with Dr. Pate, as well as analyses of public fora he has participated in, his blog, and his Twitter feed during the pandemic.

Context

Idaho is located in the Intermountain West and is a largely “rural” state—meaning most of the population of the state is located in a few urban and urbanizing areas, while the rest of the state is made up of sparsely populated public lands, Native American reservations, and land devoted to agriculture. For the last several decades the state has leaned reliably politically conservative, with the exception of a few “blue dots,” the state's larger population centers. Idaho is frequently in the news for its rapid population growth, but unlike other Western states, population growth does not seem to be turning the state politically “purple.” Instead, Idaho may be growing more conservative as a result of growth: it is, in fact, a destination for those leaving states like Colorado and California in search of relatively cheap real estate and more conservative politics (Lyons, 2017; Petersen, 2017).

Idaho is also known for several high-profile conflicts between the federal government and groups known for anti-government, white supremacist, and fundamentalist Christian views. A shoot-out between Randy Weaver and the federal government in 1992 in North Idaho is still remembered by many Republicans and Libertarians as evidence of the need for a well-armed citizenry capable of fighting federal tyranny (Geranios, 2017). Aryan compounds were rooted out in the same area after many decades of efforts by civil rights activists and government officials, but white nationalism and rightwing extremism are experiencing a resurgence there (Siegler, 2020). The Idaho Freedom Foundation (IFF), which calls itself a “free-market think tank,” exerts significant influence over public discourse and decision makers each year to restrict government spending, advocate for deregulation, and boost culture wars. Groups like IFF also share ideological traits, rhetoric, and social networks with right-wing militias in the west, who in turn share much in common with white supremacist, fundamentalist, and occasionally violent domestic terror groups that have become more prominent and powerful in Idaho and nearby states (Berlet and Sunshine, 2019). Though each can claim not to be in league with the others, together they form a web of far-right influence that has had a significant impact on how the pandemic has been perceived and managed in Idaho (Frankel et al., 2020). These groups have echoed President Trump's stance on the virus, advocated against public health measures as antithetical to individual freedom, and actively worked to undermine public health experts and the Governor's efforts to coordinate action on the pandemic, often by threatening violence (Thomson-DeVeaux and Koerth, 2020). Several state officials and lawmakers—including the state's Lieutenant Governor, Janice McGeachin—have been openly sympathetic to militia members and the Idaho Freedom Foundation and have

similarly criticized Governor Brad Little's pandemic management policies, which compared to those in other states were quite mild. For example, Little did not issue a statewide mask mandate, and spring 2020 lockdown orders were relatively brief and were lifted quickly (Armstrong, 2020).

This political context provides a particularly fecund environment in which COVID—an already rapacious and opportunistic virus—thrives. Given all of this, it should be no surprise that Idaho suffered from significant virus spikes over the course of 2020. Hospital capacity was nearly maxed out several times, and nearly 1,500 lives were lost in 2020 alone. Throughout these spikes, compliance across the state with public health guidance, such as mask-wearing, remained uneven at best, and district health boards and school districts faced tremendous pressure to act, both from those wanting stricter COVID protocols in place and from those who believed COVID was a hoax or an exaggeration. Just as the President devolved responsibility to states for managing the pandemic, so too did state officials devolve responsibility and authority to local authorities—mayors, city managers, district health boards, and school district officials. Some local officials have resigned in the face of tremendous stress, while others have faced threats to their health and safety (e.g., Corbin, 2020; Shepherd, 2020).

As the Fauci case makes clear at the national level, it can be difficult for health professionals in this environment—who typically enjoy broad public trust—to develop credibility and implement effective crisis communication messages. Given decreasing levels of trust in institutions and expertise, hyperpolarization and politicization, and the devolution and even abdication of responsibility for pandemic management, it is hard to imagine how any one organization or individual might have emerged as an authority on COVID. Individuals and organizations must operate as best they can in the face of organized interests trying to sow discord and undermining public health authority, and also in the face of rampant mis- and dis-information spread over social media. This paper focuses on how one individual, Dr. David Pate, managed to have meaningful public reach and influence on local and state decision-making and, to some extent, on public perception. I do not argue that Pate's strategies are universally effective; such a bar would be too high to set given the political context. But some of his approaches to crisis communication provide a roadmap for how others might aim to speak effectively to a variety of audiences, using social media and other platforms, under trying conditions.

Dr. Pate's Blog and the Value of Over-Communication

Dr. David Pate began his career as a physician in Texas. Later he obtained a law degree in addition to his medical degree and became a hospital administrator; it was this experience that eventually led to him being recruited away by the St. Luke's Health System to Boise, Idaho, where he served as a CEO for more than ten years. In fact, Pate was set to retire from that position on January 31, 2020. In preparation for retirement, he began a blog (called Dr. Pate's Blog) where he hoped to write about health care

policy in ways that might continue to influence the practice of hospital administration. He also set up a Twitter account (@drpatesblog) where he planned to publicize his blog posts to a broader audience. He completed two blog posts before the pandemic became widespread news in the United States. In February. His first COVID post was published on February 2, 2020. He wrote only four more non-COVID posts after that. From April 2020 through the end of the year, all blog posts were about the pandemic, as was Pate's Twitter feed, which quickly became his primary form of public communication. At the end of 2020, Pate had more than 5,000 followers, which included a number of local journalists, who frequently tapped Pate as a resource and interviewee for stories and forums. He also published several op-eds on the pandemic, participated in two hour-long question-and-answer sessions (recorded over Zoom and shared on YouTube) sponsored by Idaho's most prominent newspaper, The Idaho Statesman, and was a frequent contributor on health forums on public radio, all while serving on the Governor's Coronavirus Working Group and serving as an independent, volunteer COVID consultant for local organizations, businesses, school boards, and hospitals. In other words, Dr. Pate was not retired for long.

I first became interested in Dr. Pate's twitter feed because, as an Idahoan, parent, and educator, I was hungry for information about the pandemic's effects here in Idaho. The advice from the federal government changed rapidly and increasingly seemed tainted by political interference from the White House. Given that void, Dr. Pate emerged as a consistent and responsive voice: he translated complicated technical information clearly, admitted when he was unsure or had been incorrect in prior interpretations, responded to Twitter followers with patience and respect, and was able to provide insight into local conditions, on the ground, in hospitals, and in the state. As a result, and seeing his increasing popularity and influence, I conducted a ninety-minute interview with him in October 2020 with a particular focus on his communication strategies. I've taken transcripts from that interview, from the two one-hour video sessions he did with the Idaho Statesman, and from his COVID-themed blog posts, and imported them into *nVivo*, a qualitative analysis software. I open-coded those transcripts and posts, looking for repeated themes and communication strategies. I first labeled themes with longer titles such as "responds to specific requests for advice," "admits original understanding was incorrect," and "provides deep scientific background." Eventually, I was able to group similar themes into over-arching categories, which I describe below. The naming of these categories is influenced by my reading of crisis, science, health, and risk communication literatures, which emphasize the importance of using social media during a crisis to build relationships and communicate consistently and frequently (e.g., Eriksson, 2018); fostering relationship and credibility through two-way communication connecting scientific expertise with lived experience (special issue by Fischhoff and Scheufele, 2013, for extended discussion); modeling transparent reasoning and decision-making (e.g., Vaughan and Tinker, 2011); and acknowledging uncertainty and change (Seeger, 2006).

I've also read Dr. Pate's twitter feed on a near-daily basis since March; it was Pate's Twitter feed that clued me into his work as a communicator in the first place. I follow his feed and have asked him questions on that feed myself. However, I cannot claim to have read or systematically analyzed all of Dr. Pate's tweets: there are tens of thousands from 2020, and Twitter's algorithms shape the tweets we casually see in our feeds (they are not exhaustively presented unless we seek them out specifically). A content analysis of these thousands of tweets is beyond the scope of this paper. Nonetheless, in an effort to get a fuller, more detailed snapshot of the feed, in preparation for conducting the analysis below, I used a free Tweet scraper called All My Tweets to download and read every tweet Pate posted from mid-August to mid-October (a randomly selected time frame), totaling over 3,000 tweets. I wanted to get a sense of how frequently Dr. Pate tweeted, how often he responded to followers, and of the length, tone, and content of his tweets on a daily basis. Having done this, I feel comfortable suggesting that the analysis presented below fairly represents Dr. Pate's communication strategies as a whole. I asked Dr. Pate to read a version of this manuscript as well and to offer any feedback or suggestions for revision, and he suggested none.

Findings

Pate's approach to communication during a crisis can primarily be summed up using one word: over-communication. While some leaders might pull back during a crisis in order to avoid saying the wrong thing, or to focus primarily on operations or image management, Pate obeys the opposite impulse: communicate, communicate, and communicate some more. To accomplish this, he uses several strategies that he repeats over and over again, across the many platforms he uses to reach the public. Many of these are familiar from the literature on effective crisis and science communication (see above), but reiterating them within the context of the twin crises of COVID and challenges to democratic processes and authority may be particularly useful. The four elements of Pate's informal communication strategy are.

- 1) consistent, frequent communication
- 2) pragmatic, hyper-local advice
- 3) modeling transparency
- 4) embracing humility

I discuss each briefly below and provide examples from Dr. Pate's writing, interviews, and Tweets.

CONSISTENT AND FREQUENT COMMUNICATION

Dr. Pate shows up consistently and frequently, on a near-daily basis, to his Twitter feed. This may not seem like particularly remarkable behavior, but for a volunteer science communicator, this kind of dedication and responsiveness is notable, and follows recommendations from the crisis communication literature that emphasize using social media more effectively to foster two-way

communication during a crisis (Lin et al., 2016; Lovari and Bowen, 2019). Pate told me, "I think communication is really important because, number one, the vacuum will get filled. I have certainly been critical of other leaders, other organizations for not communicating enough. And when they don't communicate enough [people are going through a] scary time without information. And what people will do, in my experience, is they will fill in those gaps [with misinformation]." (David Pate, interview with the author, October 19, 2020)

Although there may not be much Pate can do to fight misinformation as an individual, in his view, when scientific and government authorities are not communicating often enough or adequately, misinformation floods in to fill the breach. Over-communication from informed, authoritative sources can combat that effect.

Pate over-communicates on Twitter, but also across platforms. He blogs semi-frequently, but also knows that people are unlikely to read lengthy blog posts on their own. He references his blog posts on his Twitter feed in response to follower questions, but also provides brief explanations of scientific developments via threaded Tweets, a more accessible and digestible format. As was noted above, he also does frequent and lengthy media interviews, participates on expert panels, and pens op-eds. He seems to intuitively understand that the communication field is flooded with information and content—often from unreliable sources, when it comes to COVID—and that he must use a variety of outlets and approaches to reach as many publics as possible. Audiences may not be on Twitter, or on public radio, or have a newspaper subscription. But showing up across all of these venues with a consistent message that is repeated again and again increases one's chances of being heard and viewed as a dependable source of information. He has helped followers on Twitter understand complexities about topics such as positivity rates, ventilation and its impacts on transmission, hospital capacity, death certificates, district health board decision-making, surface transmission, and how mRNA vaccines work, to name a few. In Twitter threads he links to relevant studies, other experts, and on occasion his own writing to provide further detail. Using these layered communication techniques is another form of "over-communication"—providing multiple layers of information and repetition as reminders of what we do and do not know about the virus. To the best of my knowledge, few other authorities in Idaho followed this approach in 2020.

PRAGMATIC, HYPER-LOCAL ADVICE

The literature on risk and crisis communication suggests there are at least three important communication strategies that should be used during a crisis: "building trust, disseminating information, and fostering two-way communication" (Dalrymple et al., 2016). As we saw above, Pate's consistent and frequent communication across platforms helps him to do all three; he builds trust partly through consistent and reliable responses, and his Twitter platform and question and answer sessions allow for dialogic communication. I would add some nuance to this advice by noting that Pate regularly responds to individual, highly

personalized questions, no matter how specific or minor they may seem. This may seem like an obvious strategy, but it has been incredibly important given the political context, which has left pandemic management primarily up to the individual as the decision-making unit. I refer to this approach as paying attention to the “hyperlocal,” a phrase borrowed from journalism, referring to communication “at the unit of the individual,” who is navigating a particular lived experience at the level of the banal (e.g., Harte et al., 2017). Even though scientific and medical experts coalesced relatively quickly around a core set of guidelines such as mask-wearing and social distancing, the field of information was already polluted by mis- and disinformation and political actors seeking to cast doubt on the existence of the pandemic, its origins, and appropriate responses to it. Individuals have had to step into this gap, navigating potentially life-threatening risks, using their own heuristics and drawing on their preferred experts to guide everyday actions and behaviors.

In other words, individuals—including me—were often confused about how to behave safely given our complicated, individual contexts and lack of clear guidance from authorities. Dr. Pate stepped in to provide advice. His Twitter followers clearly feel comfortable asking him very specific questions about their own behaviors and misunderstandings, and his views on COVID-related politics and policies. Here is one example, from Twitter, which is typical of the types of back-and-forth Pate invites (I’ve threaded together replies for readability).

“Kelley Kolpitcke (McCarten): I would like to know what plans @uidaho [University of Idaho] is planning to do with students who elect to stay put through November, December, and January. If the risk is too great for them to go home, then what? #quagmire.

Dr. David Pate: I am glad that I am not in a position of having a college aged child or grandchild. But if I did, here is what I would do: Have a talk with them and see if our goals are aligned that they want to come home for the semester break. If so, discuss the risks and the steps they can take to reduce the risks—for the 2 weeks prior to coming home, don’t go to bars, parties or other gatherings, and stay in their dorm room or apartment. Don’t have guests over. Take whichever classes they can remotely, but if they have to be in class, physically distance and wear masks—at all times! If they have to fly home, take the precautions that I tweeted earlier today. When they get back to town, put them up in a hotel room. You can get together outside and 6 feet apart, but don’t have them stay in your house. Do a strict quarantine. Then, if no symptoms, after 14 days, they move into the house.” (Dr. David Pate, October 17, 2020).

This Twitter follower clearly has concerns about the policy being implemented by the university, which has left the follower responsible for figuring out how and whether their college-aged student can come home for the holiday. Dr. Pate provides specific guidance for how a visit could be safely managed. This is not to say his advice is the only advice, or that other experts couldn’t give different advice. Rather, what is important is that Pate takes the time to spell out specific guidance in response to the question.

Another example may illustrate Pate’s attention to some Idahoans’ need for more specific guidance about everyday behaviors. During a videorecorded Q&A over Zoom hosted by

The Idaho Statesman, the interviewer—journalist Audrey Dutton—asked Pate, “Well, what do you think of sports I mean, we’ve got schools doing indoor sports right now. Is that something that’s safe?” (Pate, 2020a). The question of students being able to participate in sports in 2020, and whether their family members could cheer them on, has been a major driver of anxiety around COVID policymaking in Idaho, so much so that it became a focal point of discussions to limit the Governor’s emergency powers during the 2021 legislative session. But this kind of question is also of great interest to parents who are not sure if they should allow their children to return to in-person schooling and sports participation. Here is how Pate responded:

“Well, I get that question all the time, and I have a number of follow up questions, [like] which sport? I’ve been asked about swimming, swimming overall is pretty safe. On the other hand, I’m having a little bit of a panic attack because I heard that Boise school district is planning to start wrestling next week. If you asked me to pick the most dangerous sport you could imagine [for COVID transmission]? I’d say wrestling. So not all sports are created equal is one thing.

And then the second thing is it’s not just the sport activity. So as I said, for example, let’s take swimming as the example, is swimming safe? Pretty safe. You aren’t gonna be wearing a mask while you swim. You shouldn’t. But you’re gonna be in a swim lane, you’re gonna be moving, you’re not gonna be real close to others. That’s pretty safe. But now, on the other hand, if you tell me when that swimmer is not swimming, that that swimmer is congregated on the side of the pool with four or five other swimmers who are not wearing mask, and they’re all cheering on their teammate, well, now it’s just become dangerous” (Pate, 2020a).

Again, absent clear information and systems coming from the federal and perhaps state levels, Pate steps in to provide informed suggestions for how individuals might choose to act given tremendous potential risk and uncertainty. This is the advantage of focusing on the hyper-local; it helps to build trust and responsiveness at a very personal level, and provides a sense of relief and connection at an otherwise isolating or alienating time. Furthermore, Pate models risk-informed reasoning for audiences. In this example, he articulates why swimming might be safe, but participating in the competition of swimming (clustered together, unmasked, cheering on your fellow swimmers) might not be. He has also done the same for organizations, volunteering and providing insight to a number of schools and school districts seeking feedback on their opening plans and operations.

MODELING TRANSPARENCY

In addition to providing advice, Pate is also a critic of pandemic policy and politics. When Pate critiques local school boards or district health boards, it is most frequently because they are not being transparent about their reasoning or decision-making calculus. Pate articulated at length in our interview how one of the most important lessons he learned as CEO of a health system was to first gather as much input and expertise as possible, then to

make a decision, then to articulate why that decision was made, and then to take responsibility for that decision:

“[As a CEO] I can’t make a decision that everybody’s going to be happy with, but I do [want you, as an employee, to know that I] appreciate your input. I’ve heard it, I’ve valued it. And let me tell you what my decision is. And let me tell you why I made that decision. My decision was not arbitrary. [Employees] can read my reason for making the decision. They may not agree with it. They may have wanted something that I considered less strongly or more strongly, but they know how I made the decision and that it wasn’t arbitrary. And that, in fact, it was thoughtful.” (David Pate, interview with the author, October 19, 2020)

Pate goes on to say that a lack of transparency has plagued local decision-makers during the pandemic, contributing to significant public blowback:

“I think this is the school board problem. They get advice from the public health district and they seem to take some [of the advice] and dismiss others without a reason. And frankly, when you listen to some of these meetings that are just so painful, it’s because they don’t have this decision-making framework. It’s not clear what criteria they’re basing the decision on. They make a decision and then the next week, the decision can be internally inconsistent. And so what I’ve recommended to them [is], look, you don’t have to do this on every decision, but on these big decisions, actually post something to your website and say, okay, this is what the board heard. These are the factors we considered. This is how we decided this factor, overruled this factor. And this is how we came to our decision. I said, I think, you know, there would probably be quite a few of the decisions I would still disagree with, but if you can tell me that you actually had a good reason for coming to your decision, I’ll support it. And that is, I think, the failure” (David Pate, interview with the author, October 19, 2020).

Generally speaking, Dr. Pate could be considered a pragmatist—he doesn’t believe he’ll get all Idahoans to wear a mask, nor does he believe everyone will be happy with every public health decision. Furthermore, it is important to acknowledge that Dr. Pate himself is constrained by his appointment to the Governor’s Coronavirus Working Group, and while he has freely critiqued both federal and local pandemic leadership, he has studiously avoided critiquing Governor Little’s approach to the pandemic, even though criticism of the Governor’s inaction may be warranted. He is also constrained, like many experts are, by the extreme politicization of the pandemic and political unrest in the country and in Idaho, which I described above. Nonetheless, his points about transparency and consistency are important. In a fractured information environment with low trust in authorities and institutions, having a “decision-making framework” that is clearly articulated can go some way toward easing frustration with public health and other policy decisions (Veil et al., 2011).

EMBRACING HUMILITY

Like many other scientific and emergent crises, COVID presents a challenge to communicators because conditions

change so rapidly on the ground—spikes and lulls alternate, and lulls in infection rates can lead publics and decision-makers to ease up on restrictions, which can cause spikes weeks or months later. Lag times between transmission of the disease and severe illness, hospitalization, and deaths pose problems for communicators who may be seen as exaggerating risk in advance (because they see indicators arising before the public does). Furthermore, the health system, and public health crises in general, are themselves incredibly complex, and predictions may not always be correct. For example, Dr. Pate and others predicted a spike in infections following the Christmas holidays in the United States. Which is what happened after Thanksgiving—but that spike never materialized in Idaho as expected in January (though it did elsewhere around the country); in fact, infection rates eased (Dutton, 2021). Others had predicted that the hospital system in Idaho would collapse during the November/December 2020 winter surge; though it was indeed within days of needing to enact crisis standards of care, Idaho hospitals manage to largely withstand the crisis (Dutton, 2020).

But shifting realities and projections are features of crises, not exceptions to them. In addition to articulating how transparency might work more effectively, Pate therefore also repeatedly advises that decision-makers and experts 1) acknowledge when they have gotten things wrong, 2) explain why they were wrong, and how their understanding has evolved, and 3) normalize acknowledging uncertainty and change during crises. For example, Pate often reminds readers that we don’t know enough about antibody tests to be able to make robust claims about them. In an April 2020 blog post, he writes,

“Obviously, this is a fast-changing environment. We are learning more about the virus and making technological advances every day. At some point in the near future, my advice is likely to change—when we can get accurate facts and have the data to support those facts. In the meantime, let’s not spend money that we are not going to get value for, and let’s not imagine that these tests tell us something they don’t and inadvertently put people at risk of serious, and sadly sometimes fatal, illness” (Pate, 2020b).

He also notes on Twitter periodically that he did not advise mask-wearing early on in the pandemic, but that his understanding and advice on that quickly changed as our understanding of airborne transmission developed; he is a vocal mask advocate now. On Twitter, he writes, “This is a new virus that has surprised us a number of times, and it is unfathomable that anyone has been right on everything since February about this virus. Every expert I have interacted with has admitted that [some] things they thought earlier were wrong . . .” (Dr. David Pate, September 21, 2020). Acknowledging uncertainty for Pate means having humility, acknowledging expertise, but also understanding that expertise evolves. Again, these are all challenging practices to uphold when there is broad disagreement about values and what counts as evidence, truth, and expertise. But they are meaningful commitments to aspire to nonetheless.

CONCLUSION

This Case Study highlights two seemingly paradoxical things: on one hand, many of our “best practices” for crisis and science communication hold true in the case of COVID-19 communication. The four strategies employed by Dr. Pate, described above, are echoed in much of the literature on how best to communicate during disasters, health emergencies, and other crises. Organizations, agencies, and leaders in Idaho—including many who attempted to communicate about the crisis in good faith—can learn from Dr. Pate’s efforts. The Governor’s office, for example, could have communicated much more frequently and across platforms about the virus and recommended health behaviors, a fact he acknowledged in an unusual moment of self-reflection in early 2021 (Dutton, 2021). Having someone show up day after day, answering questions and giving advice—paying better attention to the “hyperlocal,” as it were, might have amplified the Governor’s “bully pulpit” in ways that would have better served public health.

Similarly, doing more to explain decision-making that at times seemed contradictory—to Republicans and Democrats alike—might have done more to bolster public trust in state leadership. Why can bars be open, but not schools? Why do the states bordering Idaho have a mask mandate, but we don’t? Why did experts say masks aren’t necessary at the beginning, but they are now? Governor Little certainly wasn’t the only state official to struggle to explain these inconsistencies, but doing so more forcefully and more consistently may have gone some way toward countering the more extreme reactions to COVID policies and behaviors across the spectrum. Instead, he gave periodic press conferences with the same message repeated over and over again—that Idahoans needed to take “personal responsibility” to end the pandemic. This message did little to change the minds of the far-right, and left those concerned about the pandemic feeling frustrated, angry, and helpless.

Normalizing shifting health recommendations and scientific understandings of the virus from the beginning could also have had an impact; had local hospitals done more to communicate why mask-wearing recommendations shifted early on, that also could have impacted coverage of the virus and, potentially, public behaviors. Hospitals were trusted sources of information early in the pandemic, and health workers were seen as “health heroes.” Yet in Idaho, at least, they did not coordinate public information campaigns about the virus until many months after it started—perhaps worried about appearing “political”—and by then their credibility with certain publics had faded.

On the other hand, local communicators can only do so much when an issue is poisoned from early on by national actors intent on manipulating a crisis for personal gain. While health workers may have been hailed as heroes early on in the pandemic, after a state politician suggested that hospitals were falsifying COVID numbers to “make money” off the virus, and thus exaggerating its impact, the ability of healthcare spokespeople to be seen as credible by large segments of the population may have been compromised (e.g., Rogers, 2020). In such an environment, a typical “best practice” around transparency and acknowledging uncertainty may have limited success and can even backfire. In

this way, the COVID crisis has much in common with the climate crisis, from a communication perspective, in that it has been deeply polarized, is characterized by disinformation efforts, and brings up a broad set of issues for people, ranging from financial to psychological to political. There are not many shared values or trusted voices that are broadly respected enough to ease these fears and concerns across the political spectrum. Add to that the fact that the pandemic itself is an evolving scientific crisis, one where we are learning more all the time about things like transmission rates and vaccine performance, and this is a perfect storm for a splintering and radicalization of responses to policy and political decisions. School boards and public health districts have already lost trust and credibility for many audiences, furthermore, and getting that trust back may prove difficult. This challenge is illustrated by the fact that the Idaho legislature considered several bills, in its 2021 session, to strip both the Governor and local public health districts of their authorities to act during a crisis, which included the ability of municipalities and counties to mandate mask-wearing, restrict gathering sizes, and accept federal emergency funding (Corbin, 2021; Norimine, 2021).

Another limitation of using Dr. Pate as a model for crisis communicators generally is that he surely has access and influence others might not have because of his professional standing and identity, which must be taken into account when we consider why he is perceived as credible in a state like Idaho. He identifies and presents as an older white man, a Christian, and a Republican, all of which gives him standing in a politically conservative and relatively culturally homogeneous state like ours. Furthermore, he is retired, which has freed him from some professional constraints other government and health officials might be limited by, and he has the time and resources to volunteer to public communication and service. He is therefore able to be a vocal advocate for COVID policymaking on social media without some of the same fears or repercussions others might face if they tried to do the same.

Still, I argue that Dr. Pate’s communication strategies are worth paying close attention to, particularly because we see leaders across the country struggling to effectively communicate during this crisis at the local level—these leaders have faced a tremendous amount of responsibility, sometimes for life and death matters, and a lack of clear, consistent guidance from above. Many were under-prepared to operate in such an environment. We can take the growth and reach of Dr. Pate’s Twitter feed, which is relatively broad on a local scale, his influence on local decision-makers and journalists, and his professional clout in the medical community during a time and in a place where credibility is hard to come by, as evidence that he is seen by many as an important source of public health information and guidance during COVID. His approaches may therefore prove useful to leaders in business, higher education, local and state government, and in non-profit organizations.

But it is not enough to merely train more experts to communicate like Dr. Pate. More must be done to contain and curtail mis- and disinformation, particularly across social media platforms such as YouTube and Facebook. Americans must come to terms with the influence of groups who prefer for public policy to be made (or not made) through physical threats,

and with the collapse of trust in institutions and expertise. These macro-level challenges to effective crisis communication will likely make more micro-level efforts inconsequential if they are not meaningfully addressed moving forward.

DATA AVAILABILITY STATEMENT

The data presented in this article are either publicly available (see references) or are protected by confidentiality. Questions about data should be directed to jenschneider@boisestate.edu.

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ETHICS STATEMENT

This study was reviewed and approved by Boise State University Office of Research Compliance. The participant provided his written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JS gathered and analyzed all data, and wrote and edited all parts of the manuscript.

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Risks Elaborated vs. Risks Downplayed: The Effect of Risk Comparisons in Mainstream Media During Covid-19 on Risk Perceptions and Anxiety Levels

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This study examines the effects of risk comparisons in mainstream media during the Covid-19 outbreak that either expressed the severity of the outbreak or downplayed it by comparing the mortality rates of the disease to those of other risks. In an online experiment of undergraduate students at a large university in the U.S. Mountain West ($n = 78$) in early May 2020, we found that trust in government agencies played an important role in how people interpret risk messages in media. When the risks are amplified, those who hold low levels of trust in government agencies are more likely to report higher levels of anxiety. When risks are downplayed, people who hold high levels of trust in government agencies are more likely to report greater risk perceptions than those who hold low levels of trust in government agencies. The implications are discussed.

Keywords: risk perception, anxiety, mainstream media, COVID-19, risk comparisons

INTRODUCTION

Since the beginning of the Covid-19 pandemic, mainstream media sources have both downplayed and elaborated upon the risks of the disease. In early March 2020, U.S. President Donald Trump compared the disease to seasonal influenza, saying that the number of deaths occurring from each was comparable, effectively beginning months of messaging that minimized the risks of Covid-19 (Qiu and Bouchard 2020). Scientists like Dr Anthony Fauci have countered such claims by providing information about the severity of the risks. As early as mid-March 2020, Dr Fauci described Covid-19 as being 10 times more lethal than the flu in front of the Congress (Bloomberg 2020). Over time, comparisons of the rate of Covid-19 deaths to those of deaths from other prominent and common risks beyond the flu were adopted in mainstream media (McCann et al., 2020).

Scientific understanding of Covid-19 has shifted rapidly throughout the pandemic, which has created an uncertain information environment in which individuals turn to their trust in governmental and scientific agencies to make sense of the issue. An April 2020 survey showed that the Centers for Disease Control (CDC), the primary federal government agency providing guidance and protocols during health crises, was among the most trusted sources of information for Covid-19, with nearly nine in 10 Americans reporting trust in the agency (Ballew et al., 2020).

This study examines the effects of comparisons that amplify—or elaborate upon—the risks of Covid-19 or downplay them, as portrayed in prominent cable news channels, among undergraduate students at a large U.S. university in the Mountain West in May 2020 ($n = 78$). Results showed that when the risks are amplified, those who held low levels of trust in government agencies were more

likely to report higher levels of anxiety. When risks are downplayed, people who hold high levels of trust in government agencies are more likely to report greater risk perceptions.

RISK AMPLIFICATION DURING VIRAL OUTBREAKS

Mainstream media are an important source of information during pandemics and play a key role in how people perceive and respond to the risks from diseases (Wirz et al., 2020). In such outlets, it is common to see comparisons being made between emerging risks and more familiar risks (Lundgren and McMakin 2018). Such comparisons help individuals make sense of the novel and highly uncertain phenomena that they face during an outbreak of an emerging disease like Covid-19. They can also be misleading by comparing risks that can be controlled (e.g., a car crash) to an emerging involuntary hazard with no known immunity or treatment (e.g., Covid-19) (Haas 2020). Research on past viral outbreaks provides evidence that news media use such risk comparisons in their coverage. A study that analyzed how U.S. news media covered H5N1, or the avian flu, showed that nearly 40% of stories made a comparison to another risk, such as the common flu (Dudo et al., 2007).

News media can provide distorted coverage of such risk comparisons. For instance, press coverage of the risks of the H1N1 virus emphasized messages of uncertainty, conflict, and dramatization or emotional, alarming messages that personalized the risk (Rossmann et al., 2018). In a study of the U.S. coverage of the Zika virus, 96% of stories were found to contain messages that elevated the risks, while 61% contained messages that minimized the risks (Sell et al., 2018). Research carried out more broadly on the news coverage of risk comparisons shows that news media overreport mortality rates for certain risks, such as homicide rates, and underreport mortality rates for other risks, such as tobacco use, likely due to news values and commercially driven interests (Frost et al., 1997). Despite a tendency in news media to cover some risks inaccurately, there is other evidence that news coverage of viral outbreaks can be accurate. In their analysis of the H1N1 virus, Dudo and his colleagues (2007) found that approximately half of the stories that contained quantitative risk information, such as mortality rates, included a denominator. Providing a denominator when presenting quantitative risk information increases the accuracy by giving context. The evidence for such a practice is mixed, however. Coverage of the risks associated with West Nile has been found to be mostly qualitative, with quantitative risks that are rarely mentioned containing denominator information (Roche and Muskavitch 2003).

Empirical research on past viral outbreaks provides a range of evidence on how news media cover diseases. On one hand, news outlets provide comparisons of the risks of the emerging viruses to other known risks. Those comparisons can be guided by news values (e.g., conflict) and are not always provided in the context of important information, such as denominators for mortality rates. This study explores how different risk

comparisons made in news media impacted public perceptions during Covid-19.

RISK PERCEPTIONS AND ANXIETY LEVELS DURING OUTBREAKS

Public perceptions of emerging risks such as Covid-19 are thought to arise from two primary paths—cognitive or emotional (Slovic 2000; Loewenstein et al., 2001). Indeed, empirical research provides evidence that both routes are linked to how people make decisions and act on risks. People are more likely to act not out of understanding or knowledge but as a result of the characteristics that they perceive from the risk—severity, controllability, or familiarity, for instance—or as a result of the way they feel about a risk (National Academies of Sciences, Engineering, and Medicine 2017).

Therefore, this study examines risk perceptions and anxiety levels. Evidence from past viral outbreaks suggests that these variables are associated with the adoption of recommended behavior changes. For instance, studies of different outbreaks in recent years, including SARS and H1N1, show that when people have higher levels of anxiety, they are more likely to take measures that protect them from the virus (Leung et al., 2005; Rubin et al., 2009). Negative emotions such as anxiety can stimulate greater information seeking during a pandemic (Kim and Niederdeppe 2013). Other data from the H1N1 outbreak show that anxiety levels mediated the link between risk perceptions and taking an action to protect oneself, suggesting that emotional responses stimulate action for those who are concerned about a virus (Prati et al., 2011). Early data on Covid-19 show that risk perceptions and anxiety levels have both been associated with the adoption of behaviors that prevent contracting and spreading the disease, such as following quarantine guidelines (Carlucci et al., 2020).

Risk perceptions and anxiety levels are important attitudes to analyze in relation to health-related risks such as viral outbreaks due to the evidence of their important relationship to the actions that people take to protect themselves. Media messages play an important role in how people perceive the cognitive and emotional dimensions of the risk during viral outbreaks (Oh et al., 2015). Research shows that both emotional (fear) and cognitive (knowledge) responses that develop from media messages are important mediators in the link between media use and likelihood of adopting preventive behaviors (Zhang et al., 2015). We pose the following hypothesis.

H₁: Individuals exposed to the Risks Elaborated condition will have higher 1) anxiety levels and 2) risk perceptions than individuals exposed to the Risks Downplayed condition.

THE ROLE OF INSTITUTIONAL TRUST DURING VIRAL OUTBREAKS

Research shows that in addition to risk perceptions and negative emotions, trust in governmental agencies during viral outbreaks is closely connected to the actions that people take to protect

themselves from diseases and the perceptions that they hold about the diseases. Evidence from the H1N1 outbreak in 2009 shows that trust in authorities was related to recommended behavior changes, such as increased hand washing (Rubin et al., 2009). During the Covid-19 outbreak, mask wearing increased by 12 percentage points after the CDC made the recommendation (Goldberg et al., 2020). In addition, low levels of confidence in the management of COVID-19 by government officials are associated with higher levels of worry about COVID-19 (Lu et al., 2020).

Trust in the government has been linked to emotional and mental health in other risk contexts, as well. Research after the Fukushima power plant disaster found that distrust in the government was linked to symptoms of depression and anxiety (Tateno and Yokoyama 2013; Fukasawa et al., 2020; Guo et al., 2020).

People use trust to make sense of and reduce the complexity of the risks they face, and empirical research provides significant evidence for the relationship between institutional trust and risk perceptions (Siegrist 2019). Viral outbreaks develop rapidly amidst an uncertain information environment (Paek and Hove 2020). Past research on viral outbreaks shows that governmental and health authorities provide reassuring messages with information about action that people can take to stay healthy (Rossmann et al., 2018), and people use trust in such actors to guide them through crises and times of uncertainty.

Thus, there is an important connection between trust in institutions and the information that people turn to during a crisis. Research has found that media use predicts trust in institutional sources of information about science (Anderson et al., 2012). Furthermore, trust in scientists mediates the effect of news media use on perceptions of scientific and risk issues such as global warming and nuclear energy (Hmielowski et al., 2014; Qiu et al., 2021).

Governmental agencies are an important part of the information environment for Covid-19, and how people view them likely shapes how people interpret risk messages.

H₂: Individuals' trust in government agencies will moderate 1) anxiety levels and 2) risk perceptions when exposed to the Risks Elaborated condition vs. the Risks Downplayed condition.

METHODS

Study Design

An online experiment was conducted comparing a video that elaborated on the risks of Covid-19 to one that downplayed the risks of Covid-19 by comparing the mortality rates from Covid-19 to those of other major causes of death. In the Risks Elaborated condition, participants were exposed to a 10-s clip that aired on March 17, 2020, during which MSNBC host Joe Scarborough introduced a recent report that describes the number of American deaths from Covid-19 in the worst-case scenario to be two million, or higher than the total number of deaths for the Vietnam War, Civil War, World War I, and World War II combined (Concha 2020). In the Risks Downplayed condition, participants were exposed to a 15-s clip that aired on April 17,

2020, in which Dr Phil, a prominent television personality, declares in an interview on Fox News that Covid-19 has produced fewer deaths than the following common causes of death in the United States: cigarette smoking, automobile accidents, and swimming pool accidents (Ali 2020). Neither clip attributed the mortality rates to a specific source.

Undergraduate students at a large university in the Mountain West participated in the study between April 30 and May 8, 2020 ($n = 78$). The study was approved by the Institutional Review Board of the authors' institution. See **Supplementary Material** for descriptive statistics about the sample and control variables.

Independent Variables

Trust in government agencies was measured using an item that asked people to evaluate how much they trust health information from government agencies such as the Centers for Disease Control as a source of information about coronavirus on a five-point scale, with one being equal to "none at all" and five being equal to "a great deal" ($M = 4.17$, $SD = 1.01$).¹ The item was split at the median (4), with 53% of participants ($n = 40$) in the high trust category and 47% of participants ($n = 36$) in the low trust category.

Dependent Variables

Risk Perceptions is the mean index of three items measured on a seven-point scale (Cronbach's $\alpha = 0.68$, $M = 3.57$, $SD = 1.19$): "How serious are current threats related to coronavirus to your health," "How likely are you to come down with coronavirus in the next year," and "If you were to become ill with coronavirus in the next year, how serious do you think it would be?" (Kahlor 2010).

Anxiety was measured using the mean index of the Z-score of two items. The first asked them to consider how they have felt in the past week on a four-point scale: "How often do you worry about getting coronavirus, or COVID-19?" (Zhao and Cai 2009). The second asked on a seven-point scale: "How often have you felt anxious as cases of the coronavirus have been increasing rapidly in the United States?" (Pearson's $R = 0.40$, $p < 0.001$; $M = 0.00$, $SD = 0.83$) (Kim and Niederdeppe 2013).

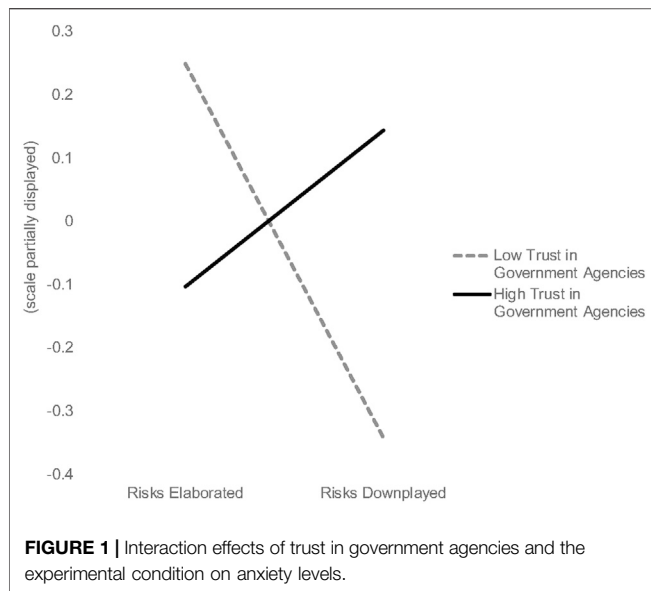
Analyses

This study employed a two-way analysis of covariance (ANCOVA) to test our hypotheses. See **Supplementary Material** for information about the manipulation checks.

RESULTS

The first hypothesis examined the main effects of the experimental video on levels of anxiety and perceptions of risk. It was not supported. There were no main effects of the experimental condition on anxiety [$F(1, 70) = 0.82$, $p = 0.369$] or risk

¹Previous work has used single-item measures to operationalize trust in sources of information for science as both an independent and dependent variable (Eiser et al., 2002; Brewer and Ley 2012; Larson et al., 2018).



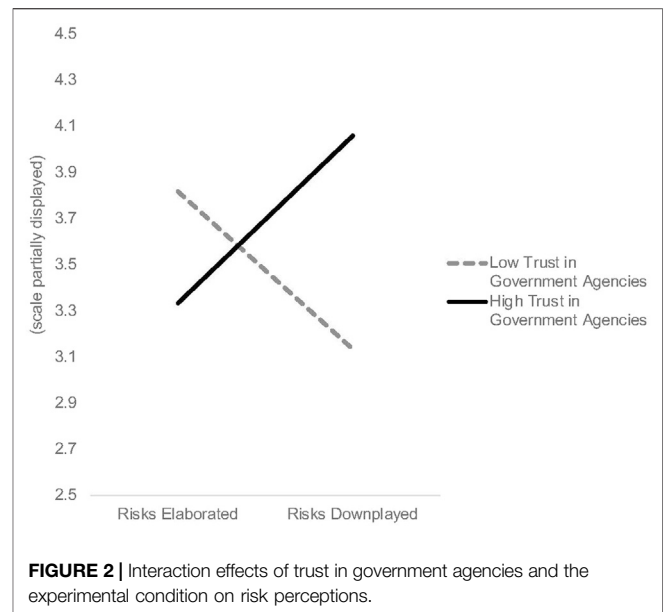
perceptions [$F(1, 68) = 0.06, p = 0.801$] after controlling for race, sex, political ideology, trust in MSNBC, and trust in Fox News.

The second hypothesis explored the interaction effects of trust in government agencies and the experimental condition on anxiety and risk perceptions. The interaction effect of trust in government agencies and the experimental condition on anxiety was statistically significant [$F(1, 70) = 5.14, p < 0.05$] after controlling for race, sex, political ideology, trust in MSNBC, and trust in Fox News. Those who hold low trust in government agencies held higher levels of anxiety when they saw the Risks Elaborated video vs. the Risks Downplayed video (see **Figure 1**). Those who hold high trust in government agencies held similar levels of anxiety, regardless of the video they saw. The interaction effect of trust in the CDC and the experimental condition on risk perception was statistically significant [$F(1, 68) = 7.36, p < 0.01$] after controlling for race, sex, political ideology, trust in MSNBC, and trust in Fox News. Those who hold high trust in government agencies were more likely than those who hold low trust in government agencies to hold higher levels of risk perceptions in the Risk Downplayed condition (see **Figure 2**).

DISCUSSION

The goal of this study was to examine the impacts various comparisons of risk in mainstream media can have on risk perceptions and anxiety levels during an emergent disease outbreak. Our study provides evidence that trust in government agencies moderates the relationship between risk comparison portrayals and how individuals perceive the risk of Covid-19 and experience anxiety about it. This points to the important role of institutional sources of information in how people interpret portrayals of risk.

Before discussing the findings further, it is important to note a few limitations of this study. This study examined the effects of mediated messages from a moment in time during a rapidly



changing media environment, using a sample with limited diversity. It is possible that other characteristics of the clips (e.g., source characteristics, such as likability or competence, or perceived accuracy) contributed to the effects that we found. Our analyses control for a number of factors, including demographic characteristics, political ideology, and source perceptions for Fox News and MSNBC, which does provide support for isolating the effects of our independent variables of risks elaborated vs. risks downplayed. In addition, our study also had high external validity. The clips tested in the experiment were taken directly from aired national broadcasts and represented messages commonly portrayed in mainstream media sources. More expansive research could test a broader range of risk comparison messages from a range of sources while controlling for source perceptions. Furthermore, while our sample of college students represents a particular age group with arguably more limited risk of the disease, the study was also fielded in early May 2020—a time when most individuals around the world were under or had recently come out of a stay-at-home order. The experiences of a college student during this time were possibly not so dissimilar to those of other individuals at different life stages. While the individual situations people experienced were unique, all individuals were living under the broader umbrella of stay-at-home orders and stressful circumstances. Furthermore, many college students were living with their families during this time, making their experiences more aligned with those of the broader public than a typical college experience. This relatively homogeneous experience among individuals in different places supports the case for testing a small sample of college students. Future research should continue to explore the risk comparisons being made over the long term and after more intense politicization has occurred, such as the divergent government responses in terms of recommendations to manage Covid-19 in the summer months of 2020. An additional limitation of our study is the use of a single

item to measure trust in governmental agencies, given the multidimensional nature of the construct (Besley et al., 2021). While this study employs a measure of institutional trust that is commonly used in research, it is important that science communication researchers move toward multidimensional measurements of trust that account for its complex nature. We also use an item that uses the CDC as a specific example when we asked about levels of trust in government agencies. While additional agencies (e.g., the Food and Drug Administration) could have been used as examples in the measurement of trust, the CDC tends to be among the most well known (Myers et al., 2017). Moreover, people do not tend to view such institutions that differently.

Our data show that elaborating upon the risks of Covid-19 in a risk comparison message can draw out greater anxiety from those who hold low trust in government agencies. It is likely that individuals with low trust in scientific organizations like the CDC that provide some of the main guidance during health crises were in a cognitive state in which their anxiety levels were easily stoked by alarming messages. Given that institutional trust can be a guiding factor in how people manage such uncertainties, their levels of anxiety were easily stimulated by messages that heightened the risks of the disease. This has important implications for understanding how individuals build resilience in the context of an ongoing pandemic. Reaching them with information that helps them foreground positive actions while also acknowledging these negative emotions is a productive outcome of this communication dynamic. It is worth noting that negative emotions like anxiety can stimulate ideal behaviors during pandemics and viral outbreaks (e.g., handwashing and information seeking). The risk comparisons being made in media outlets likely play an important part in encouraging health-protective actions for people who may not feel like they can turn to a governing body or authority during a pandemic given their low trust in such institutions.

Results from this study suggest that downplaying risks, on the other hand, appears to heighten concerns among people who hold high trust in government agencies. It is likely that those with high trust in agencies like the CDC also hold greater concern over the virus. Our study indicates that when these individuals encounter messages that do not align with their perspectives, or a message that downplays the risks, they respond with even greater concern. It is possible then that such messages could fuel even more action (e.g., greater steps taken to participate in social distancing or mask wearing) or policy support on the part of people who are already concerned. This is important given that President Trump acknowledged that he was downplaying the risks all along (Gangel et al., 2020) and when there have been reports of meddling by President Trump's administration in the reports and recommendations made by the CDC (Weiland 2020). The state of uncertainty and polarization that results from such long-term and ongoing actions may actually motivate those most concerned about the risks to protect themselves and others during the health crisis.

Research suggests that trust in scientific governmental agencies can falter when it is in the presence of a politicized topic (Myers et al., 2017). The news media environment for Covid-19 during the early phase of the pandemic was politicized (Hart et al., 2020). Some evidence suggests that this polarized

news environment is connected to attitudes about governmental agencies. A survey from March 2020 found that greater exposure to conservative media was associated with the perception that the CDC exaggerated the threat of Covid-19 in order to hurt President Trump's image (Jamieson and Albarracín 2020). These connections between polarized messaging available in mainstream media and perceptions of the CDC possibly deepened over time. About nine in 10 Americans trusted two prominent government agencies—the CDC and the National Institutes for Health (NIH)—for information about Covid-19 in a survey conducted in April 2020 (Ballew et al., 2020), yet perceptions that the CDC is doing an excellent or good job in its response to the outbreak dropped considerably between March (79%) and August (63%) (Pew Research Center 2020). This study adds important insights into how the specific risk comparisons that are so prominent in the Covid-19 discourse shaped individuals' experiences, taking into account the important role of trust in governmental agencies.

Research has begun to examine how the risk comparisons made between Covid-19 and other more familiar risks shape responses. One study found that people think that helping an individual afflicted by Covid-19 is riskier than helping an individual afflicted by the flu or a car accident, and they are less likely to help the individual afflicted by Covid-19 (Niemi et al., 2021). Our study places such popular comparisons made in public discourse in the context of institutional trust, an important orientation for understanding how people process risk because it reduces anxiety for individuals in the face of a novel uncertain risk. Here, we found that for individuals who hold low trust in the government and cannot turn to it to manage their emotional responses and mental health related to the crisis, messages that elaborate on the severity of the risks will leave them with more anxiety. The implications of this may indicate that it is important for public health officials to make other sources of trust—such as religious leaders, doctors, or members of one's social network—available to those with low trust in the government to help them manage their feelings of anxiety during such crises.

We also know that those with high trust in government agencies tend to hold greater risk perceptions. Our study found this pattern between high trust and high risk perceptions to be even greater in the face of messages that downplay the risks. This evidence suggests that viewing these downplayed risks triggers even greater concern for those with high trust. It may be that these individuals have already heard messages from their trusted authorities stating that the risks are serious and are worried that others will not take the risks as seriously if they see the risks downplayed. Notably, even though those with high trust in governmental agencies reported more risk perceptions in the face of messages that downplay the risks, their levels of anxiety were not impacted.

Early in the Covid-19 pandemic, the WHO declared an "infodemic" in which inaccurate information was spreading rapidly in various traditional and digital media sources. While empirical research is still developing on how media portray the Covid-19 pandemic, future research should examine how risk

comparisons—including how accurate those portrayals were—played out in news media sources and whether there was an uptake of those messages in social media conversations. This can provide further insight into the reach of such portrayals from prominent political actors in public discourse and the potential effects of them. Future research should also examine how people rely on trust in governmental agencies to manage their emotional responses to media messages during other crises (e.g., social justice issues).

Our data show that the levels of institutional trust, combined with the repeated messages that downplay or elaborate upon the risks purported in media *via* major political actors, can have significant consequences with regard to how people perceive the issue. When individuals hold low trust in a scientific governing body like the CDC, their anxiety levels are provoked by messages that elaborate upon the risk of Covid-19. This suggests that those who cannot turn to institutional trust during health crises need other mechanisms for coping with the mental health impacts of such events. For those who do hold trust in governmental agencies, the use of messages that downplay the risks stimulated their risk perceptions, but their anxiety levels remained the same. This suggests that these individuals are able to turn to their trust in the government to manage any anxiety that might arise from media messages during a health crisis such as a pandemic.

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DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Colorado State University Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

AA contributed to the research design, data collection, data analysis, and manuscript development. GS contributed to the research design, data collection, and manuscript proofreading.

SUPPLEMENTARY MATERIAL

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Staging Expertise in Times of COVID-19: An Analysis of the Science-Policy-Society Interface in the Dutch “Intelligent Lockdown”

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The corona crisis of 2020 took many by surprise. Quite suddenly, politicians had to make drastic decisions to guarantee public health, affecting basic civil liberties. In justifying their decisions, politicians internationally reverted back to a direct staging of experts to legitimize their proposals for what internationally became known as the “lockdown”. In this article we analyze the performance of the Dutch government that, early on, labeled its approach to COVID-19 as an “intelligent lockdown”. Our analysis examines the dramaturgy of expertise during this period. We selected two interrelated “stages”: the official press conferences, fully controlled by the government, and the responses on Twitter, as focal channel for critique from the general public, but also from opposition parties and (alleged) experts. 26 press conferences of the Dutch Prime Minister were analyzed and a search for the most popular posts on Twitter referring to the press conference(s) was carried out covering the period between March 6th and May 29th, 2020. The results show that the technocratic framing of expertise remained stable during the sampling period, regarding the undisputed status of expertise as the clear-cut basis for decision-making in uncertain times. Framing on Twitter challenged the omnipotence of the experts advising the government in various ways, namely, by referring to dissenting opinions of other experts, by questioning the underlying motives of experts’ advice or by pointing out that the policies were clearly contrary to everyday experience. We argue that it is not so much the facts themselves that are at stake here but *hidden moralities*, which include the government’s alleged complacency while asking citizens to blindly trust, its unpredictable behavior in the light of the promised straight line between scientific evidence and policy making, and its motivated behavior while claiming that the facts speak for themselves.

Keywords: framing, COVID-19, expertise, hidden moralities, press conferences, Twitter

INTRODUCTION

Effective management of the COVID-19 crisis required strong and lasting collaboration between policy makers, scientific experts and citizens. From the outset the Dutch approach was aimed at making citizens collaborate. This collaboration depended upon citizens’ trust in expert advice and their judgment of the situation. However, this trust in expert advice could by no means be assumed.

On the contrary, persistent debates rooted in what experts consider solid science, such as climate change or vaccinations, have been showing for some time now that the authority of experts is not a matter of simple, let alone, unconditional acceptance (Hajer, 2009; Oreskes and Conway, 2010). Experts increasingly find themselves in a situation where they must publicly earn their own credibility (Hilgartner, 2000; Jasanoff and Simmet, 2017; Turnhout et al., 2019).

Over recent years, the contestation of expertise has shifted from disagreement with experts to a situation in which experts and expert organisations are regularly confronted with cynicism, where people's distrust extends to the intentions and motives of those organisations. Responses range from a persistent "Why can't we just ask a question?" to fierce, personal attacks on social media and vehement protests on the streets. It begs the question of what drives and gives substance to these disputes, a question that has become all the more relevant in the context of the COVID-19 pandemic, in which democratic decision-making has become unprecedentedly dependent on the advice of scientific experts (Akerman et al., 2020).

In the Netherlands, scientific expertise was already heavily and publicly contested before the COVID-19 pandemic. For example, in 2019, a judge ruled that the nitrogen pollution caused by emissions from agriculture was not in line with the law and should be drastically reduced. Farmers' organisations contested the objectivity of the National Institute for Public Health and the Environment (RIVM) in modeling the influence of nitrogen emissions on nature. Some farmers suggested a conspiracy against the agricultural sector. As it happened, it was the very same institute, the RIVM, which in early March 2020 called upon the government to take drastic measures to prevent a collapse of the healthcare system. The combined effects of international holidaying and Carnival presented such an increase in COVID-19 infection rates that the meticulous "track and trace" system to control diseases and epidemics no longer was a viable option. Consequentially, the Prime Minister directly addressed the nation on March 16th, the first time after 1973, to announce the "intelligent lockdown". Compared to the extensive restrictions of other European countries in the same period, there was no curfew during the Dutch "intelligent lockdown" and even shops could keep their doors open under certain conditions. Simultaneously, there was a heavy emphasis on the responsibility of individuals to adhere to basic guidelines such as social distancing or self-isolation in case of COVID-like symptoms.

For a society whose functioning and well-being depend almost routinely on the effective and legitimate use of science, and to which this is even more true in times of crisis, new avenues need to be explored to re-value the position of scientific expertise in policymaking. Truth claims in the Western public sphere have been treated as sufficient and robust *only* when associated issues of public value and purpose were addressed in tandem, as Jasanoff and Simmet (2017) point out. It is not so much scientific facts in themselves that may offend people, but the (denial of) values associated with these facts. This means that looking at disputed expertise includes studying the role of morality. In this article, we therefore examine the institutional performance of scientific

expertise *in conjunction to* value-creation, and the public appreciation thereof.

The Dutch COVID case allows us to study how a polity with very well established and generally recognized knowledge institutions (Wardekker et al., 2008; Huitema and Turnhout 2009; Van Asselt et al., 2014) responds to the need of a new enactment of scientific authority. The established but publicly little-known connections of these institutes with policy makers proved to be an advantage in establishing a repertoire of science-policy interaction, in the sense that knowledge specialists and policy makers could easily find each other. However, it also turned out to be a handicap, as the close relationships made them vulnerable to allegations of interests. An important and early part of this science-policy interaction in the context of COVID-19 will be analyzed in this article.

FRAMING EXPERTISE

For our analysis of the debates, we rely on a framing approach. In the often-cited definition of Entman (1993, p. 52), framing entails "select [ing] some aspects of a perceived reality and mak [ing] them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described". In empirical research, the actual conceptualization of framing differs considerably across studies. In our efforts to understand how the COVID-19 debate evolved between different actors on different platforms, we rely on an interactional understanding of framing, wherein framing is regarded as a dynamic process of co-creation between participants and where meaning is therefore negotiated (Edwards, 1997; Dewulf and Bouwen, 2012). We describe this process using two key principles in the framing literature. First, we consider diagnostic and prognostic elements to be crucial aspects (Snow and Benford, 1988; see also; Kroon et al., 2018). Diagnostic framing relates to problem definition and answers the question of what the problem is and who is responsible for it. Prognostic framing provides potential solutions and also indicates who can alleviate the problem. Second, the actual manifestation of frames in texts is through so-called 'packages' (Gamson and Modigliani, 1989, see for a recent application; Wichgers et al., 2020). At the core of such a package is the frame, that provides meaning to issues or events, and comes with a range of manifest framing "devices", such as metaphors, word choices, descriptions and arguments, that are related to the frame, and its diagnostic and prognostic components. In some instances, these components are explicit and manifest, in other instances, they have to be inferred from the larger context (Pan and Kosicki, 1993). The challenge is thus to identify those framing packages and analyze their contribution to the ongoing process of defining issues, ascribing responsibilities, claiming rights and building identities (cf. Dewulf et al., 2009).

Even though we regard the framing process as essentially co-constructed, ample research has shown that the larger context in which public debates take place seriously constrain the range of possibilities available to those involved (Vliegthart and Van

Zoonen, 2011). Most notably, it is those with political power that set the scene and indirectly the boundaries of the range of opportunities others have to express their views without completely “falling on deaf ears” (Snow and Corrigan-Brown, 2005). In the specific context of our study, framing boundaries were largely set during press conferences. They formed the stage where the official government measures to combat the pandemic were announced to the Dutch citizenry. These events were broadcasted live on the major public and private television channels, on multiple online news sites and on YouTube, and were perpetually referenced in newspapers and television news. The press conferences alone consistently attracted many millions of viewers, with the four most viewed press conferences in the sampling period reaching an audience of more than 7.5 million citizens (SKO, 2021, January 7). For counter voices to receive more than just marginal attention, they will usually have to find ways to align their challenging frames with the framings of those who wield political power (Snow et al., 1986). We consequently expect that government actors 1) are leading the debate, thus providing a central interpretation of the problem definition, diagnosis and prognosis; that this 2) constrains the opportunities of other actors to bring forward a radically different framing; and that 3) actors will present their own (challenging) frames that extend or transform the boundaries of the dominant, governmental framing (Snow et al., 1986).

HIDDEN MORALITIES

On the surface, disputes regarding COVID-19 policies revolved around questions that would typically fall into the jurisdiction of science, like “Can a relevant level of herd immunity be achieved to mitigate the spread of COVID19?” or “To what extent do face masks prevent the spread of the virus in public spaces?” However, experience shows that such conflicts cannot be resolved simply by providing more facts (Shapin, 2007). When facts are controversial and there is a lot at stake, correcting misinformation will not so much allay existing concerns but reinforce them (cf. Nyhan and Reifler 2015). Moreover, in these kinds of controversial situations, citizens refer to facts and figures just as frantically as experts do (Te Molder, 2012; Te Molder, 2014; Versteeg et al., 2018). Both phenomena suggest that the cause of disagreement does not lie in science as such; it transcends science’s (fuzzy) boundaries. When knowledge is at stake, so are the values associated with it (Jasanoff, 2004; Jasanoff and Simmet, 2017; Durnová, 2019).

In this study, we therefore pay attention to how both government and civil society actors attend to these values when making sense of corona policies and the role of scientific expertise therein. We use the term “hidden moralities” to emphasize that we are analyzing practices that normally remain under the radar. Swierstra et al. (2009) point out that *morality* exists in daily life of practical routines that are difficult to articulate whereas *ethics*, on the other hand, is marked by explicitness, reflection and controversy. Moralities are not easy to distinguish because they present themselves in close harmony with the facts people use. They comprise conceptions of what constitutes a good relationship, for example between

governments and their citizens, or what entails a good life more generally (ibid.). Vaccine-hesitant parents tend to use science to make their point, rather than directly referring to the idea that a good parent should not blindly trust (Te Molder, 2012; Reich, 2016). Climate sceptics suggest that abatement measures are ineffective rather than publicly unpacking notions of good governance.

We agree with Jasanoff and Simmet (2017, p. 764) that “we must remember to ask, and insist on good answers to, questions about *what underpins both sets of authority claims* [i.e., scientific and political, our addition and emphasis] in the first place” and pay attention to issues such as “Who made the claim?”, and “In answer to whose questions or purposes?”. In many cases, however, the answers to these questions are difficult to provide because facts and values are so intimately linked. The “mixing” of facts and values is, for a large part, a tacit and practical achievement, that can only be understood when viewed in the context of everyday life. Before knowledge-political repertoires can be disentangled and considered, at least to some extent, we must first surface hidden moralities as they are attended to by participants themselves, in real-life interaction. To this end, we propose a combination of a framing and a discursive analysis.

DATA AND METHODS

To investigate when and how the Dutch government framed experts and expertise when formulating problems and proposing solutions, publicly available transcripts of the Prime Minister’s press conferences have been analyzed. These events summarized the newest developments discussed during the prior crisis- or Ministers gathering and provided journalists the opportunity to ask follow-up questions. Whereas the Prime Minister was part of all press conferences, some featured additional key figures of the crisis, like the Minister of Public Health or the chair of the Outbreak Management Team. During the sampling period, starting from the first confirmed corona patient in the Netherlands on February 27th until May 31st, 26 press conferences were organized, including the ones that take place each Friday after the meeting of the government council. We collected them from the official site of the Dutch government.¹ The respective transcripts were split between two of the authors and qualitatively analyzed for all references to individual, institutional or categorical expertise. Here, we were guided by questions such as what was considered to be the problem, what the underlying causes for the problem were and what was presented as the potential solution. For this, we relied on an inductive approach. Core questions that were answered are how the larger pandemic was presented as a problem (diagnosis), as well as whether and in what ways science and scientists could offer relief for the consequences of the pandemic (prognosis). We looked for manifest

¹<https://www.rijksoverheid.nl/regering/bewindspersonen/mark-rutte/documenten?type=Mediatekst&startdatum=27%2D02%2D2020&eindeinddatum=31%2D05%2D2020>

metaphors, phrases and arguments as indicators for underlying diagnostic and prognostic framing elements. Only those sections that dealt with COVID-19 were analyzed. Cross analyses of four randomly chosen transcripts indicated robust agreement of expert references between analysts. They selected the same relevant excerpts and also provided highly similar interpretations of the framing of expertise. This approach resulted in a collection of around 100 paragraphs, each of which contained at least one reference to expertise, science or individual experts. These paragraphs provided the basis for describing dominant framings of expertise.

Second, a discursive analysis was performed to scrutinize the *uptake* of these governmental messages on Twitter. We were interested in *what* aspects recipients made relevant from earlier messages and how they thereby *treated* the utterance, i.e., as what kind of action, for example, an accusation, a compliment or an offer (Potter, 2012; Te Molder, 2012). This step allowed us to analyze how participants themselves attended to (hidden) moralities, similar to how, for example, participants in anti-vaccination forums suggest that “a good parent” should refrain from blind faith in government and science, by accusing parents of naivety when they fail to check the facts before accepting them (Versteeg, 2018).

For this part of the analysis, we used Coosto, which provides an online archive of Dutch language Tweets. As one of the biggest, freely accessible social media platforms, Twitter offers a forum to all citizens who aim to join the public discussion about the government’s corona policies. During times of crisis in general and outbreaks of infectious disease in particular (for an overview, see Tang et al., 2018), scholars have increasingly turned their attention to Twitter to understand how people make sense of the situation (e.g., Vos and Buckner, 2016; Stieglitz et al., 2018). Twitter might not be a perfect representation of public opinion or views (McGregor et al., 2017), in that it analyses public voices in a restricted and somewhat magnified form. On the other hand, it offers insight into what normally may remain marginalized voices. All in all, it offered us an accessible and suitable forum to analyze initial responses to the content of press conferences. The use of hashtags related to the press conferences and announced measures provided us with ample opportunity to select relevant Tweets.

We developed a search string to identify these relevant Tweets—i.e., those that referred to 1) COVID-19, 2) the press conferences and 3) expertise (either in the form of reference to the main advisory bodies of the government, or to science or knowledge generally).² This search revealed 10 days in the sampling period wherein the number of Tweets relating to the search query was peaking, ranging between 31 and 266 Tweets per day. From each of the days, the twenty most commented posts (including their respective comments) were sampled. Selecting the most commented Tweets, rather than the software’s option to sort by “influence”, effectively excluded Tweets from the dataset that gained lots of views by virtue of their large followership only. This approach ensured not disadvantaging Twitter users with a small to medium followership, compared to large institutions or

prominent individuals on the platform. Retweets were excluded from the sample at the last step of selection.

RESULTS

We present our results in pairs of three. For each pair, we first describe one aspect of the expertise framing in press conferences. Subsequently, we show how people on Twitter respond to that framing and demonstrate how this uptake points toward a moral concern that remains (largely) unaddressed but is of crucial relevance to the development of the COVID-19 debate. An overview of the findings can be found in **Table 1**.

Press Conferences: Trust the Virologists

References to expertise were most frequently used to emphasize that decision making is based on expert advice. From the very beginning, it was established that the Dutch Institute of Public Health and the Environment (RIVM) is the government’s primary scientific advisory body. From March 12th onwards, an Outbreak Management Team (OMT) was assembled to provide scientific input for governmental decision making and coexisted as initialism for an expert body next to the RIVM. However, it was publicly known that most OMT members are either directly employed by the RIVM or are strongly affiliated with it and therefore it made little difference whether government officials referred to one or the other. On various occasions during the press conferences, the Prime Minister suggested that these are the experts that will provide the intelligence and know-how for outbreak management policies (March 6th: *...that this really requires specific expertise from the GGDs³, from the RIVM. So, they are very important. They are also, world-wide, among some of the best experts in the world in this field. Fortunately, we have them in the Netherlands. And it is very important to build on their advice*). When a high-profile doctor publicly announced that hospital capacity allowed for a loosening of outbreak measures on April 24th, the Prime Minister was confronted with the question of why he did not follow up on that insight. In response, he pointed out that the advice of around 40 OMT members weighed heavier than that of a single expert (April 24th: *We rely on the advice, of a group of forty experts really (...) we cannot make our decisions based on one physician*).

Next to this institutional demarcation of expertise, extensive boundary work was performed on different categories of experts: During the sampling period, virologists were repeatedly put forward as the ones who possess relevant knowledge (March 9th: *I’m not a virologist, neither are you, I believe. This is really specialist work; And to be honest, the Netherlands has made a very big mistake of making me Prime Minister, because I am not a virologist. If only I were one, I could have thought of it all myself*). Others, like legal experts and historians, should not be making decisions because the unique circumstances require a very particular expertise (March 12th: *But the advice of experts is important because this is a highly specialized problem, and you*

²The following search string was used (covid* OR corona OR virus) AND (ggd OR omt OR “outbreak management team” OR expert* OR deskundig* OR wetenschap* OR adviseur* OR advies OR rivm) AND persconferentie.

³Refers to the Municipal Health Departments (Gemeentelijke Gezondheidsdiensten).

TABLE 1 | Framing Experts and Expertise: An overview.

Framing	I.	II.	III.
Press conferences	Trust the virologists	Policies stem directly from scientific evidence, whether certain or not	While embedded in politics, fact still speak for themselves
Twitter	Why would we trust blindly? Portraying government as a complacent actor	There is no logic to these policies. Turning government into a whimsical actor	When stated that facts speak for themselves, we suspect something else: identifying the government as an interest-driven actor
Topics	Other countries, other experts	Schools; face masks	Schools; face masks; herd immunity

have to be careful that a lawyer or a historian will not ultimately make all decisions). Taken together, this governmental framing followed the reasoning of three connected steps: First, it is up to highly specialized individuals to define problems and propose solutions related to the COVID-19 pandemic. Second, the epitome of highly specialized individuals is to be found in the OMT and nowhere else. Third, these experts should receive the trust of citizens (March 13th: *Then I think the Netherlands has reason to trust in the experts who advise us*). They are thus presented not only as those who have the right to propose measures, but those measures also logically flow from the experts' unique expertise and therefore deserve "blind" faith.

Twitter: Why Would we Trust Blindly? Portraying the Government as a Complacent Actor

This governmental sentiment gained a lot of attention and created a considerable amount of pushback on Twitter. Typical reactions to it are depicted in Tweets 1, 2 and 3 below. Their first common element is that they all challenge the scientific foundation on which the government takes action, thereby achieving quite the opposite of the governmental plea "leave it to the experts". It demonstrates that citizens have a stake in the scientific advice that translates into policies which in turn directly affect their lives. Secondly, by keeping a close eye on the experts and reserving the right to criticize, especially as non-experts, Tweeps⁴ make it clear that they will not trust experts blindly. People who do trust without questioning, are being compared to sheep that simply follow wherever the herd may go (Tweet 3).

1) 72 followers 3.2 influence 1,278 comments⁵

Borrowed from @[-] Hello @rivm and @[Hugo de Jonge, Minister of health] and @[Mark Rutte, Prime Minister] where can I find the scientific basis for this advice? Publications say otherwise ... # facemasks #coronavirusNetherlands #pressconference #scarcity non-argument.

⁴a person who uses the Twitter online message service to send and receive tweets.

⁵"followers" indicate how many other people follow the Tweet's author; "influence" is a score that indicates how likely it is that Tweets by that particular author will be seen by other people; "comments" display the number of responses that particular Tweet has generated.

2) 460 followers 1.4 influence 954 comments

Wilders is right. Scientific research shows that infections mainly occur within and after prolonged contact. It is a pity that Rutte and De Jonge do not explain how they arrive at their insights.

3) 1,644 followers 7.0 influence 24 comments

Pointless exercise regarding facemasks. "The experts" say ... not necessary. That in the meantime the whole world advises otherwise doesn't bother them. But all #sheep keep on clapping for "the statesman and co". Honestly, this country. #pressconference.

Thirdly, the Tweets suggest a strong contrast between advice from the Dutch OMT and views of other expert entities. These other entities include the scientific community and publications (Tweets one and 2), the alleged superior approaches of other countries (and their expert advisors) (Tweet 4) and individual scientists (Tweet 5). The plentiful references to expertise outside of the OMT treats the government's exclusive focus on OMT advice as an unwillingness to broaden their horizon and learn from others. In more extreme cases, the disregard for other experts' opinions is interpreted as self-righteous behavior (Tweet 5), which is suggested to further undermine the government's trustworthiness. This type of counter framing does not call into question the authority of scientific expertise as such and therefore does not provide a fundamentally different interpretation in terms of diagnosis and prognosis. However, it does dispute the inevitability of the specific institutions and experts the Dutch government relies on.

4) 6,022 followers 5.4 influence 15 comments

#Rutte and the RIVM are doing their utmost to guide the Netherlands through the #Corona crisis. But dear experts, do you monitor the Scandinavian approach? Sweden (10 million inhabitants), for example, has 3 times fewer infections and 7 times fewer deaths! #pressconference #coronanederland.

5) 11,239 followers 130.6 influence 801 comments

If Minister de Jonge hears this, he jumps out of his skin. He was already angry about it during the press conference. A professor of medical microbiology with his own initiative, indeed, things shouldn't get any crazier in this country. #coronavirusNetherlands.

Press Conferences: Policies Stem Directly From Scientific Evidence, Whether Certain or not

When the first corona patients were confirmed in the Netherlands, the government took the stance that the situation was under control. This claim was supported by reference to experts' levelheadedness in the face of a potential public health crisis (March 6th: *And one is always impressed by the calm and expertise and the focus and the enormous dedication in which all this happens*). The growing number of infections made clear that the tracking and tracing of individual cases would soon become impossible. In the light of this development, a lack of knowledge was first problematized on March 12th (March 12th: *The fact is that in a crisis like this you have to make 100% of the decisions with 50% of the knowledge*). From this point onwards, uncertainty remained a part of the expert framing, but it evolved over time. During the first half of the sampling period, uncertainty was portrayed as a general nuisance of life rather than something that obfuscates expert advice. For instance, the WHO's declaration of a coronavirus pandemic has been instrumentalized to point out that foreign introduction of the virus can have unpredictable consequences for an open country such as the Netherlands (March 12th: *we have cases all over the world and that of course has consequences for an open country like the Netherlands*). Consequently, this particular framing of uncertainty led to an almost unconditional reliance on experts, as they were portrayed as the only ones capable of addressing and dealing with uncertainty (March 12th: *You can never be 100 per cent sure whether you are doing exactly the right things. But we do things based on the latest scientific insights*).

At this stage, uncertainty was portrayed as external to expert advice and therefore unaffected by it. This sentiment was essential in creating one of the biggest controversies during the early pandemic, the question of whether or not to close (elementary) schools. On March 13th, the Prime Minister announced that schools were meant to remain open and that this decision was motivated by medical considerations (March 13th: *Medical experts advised us on that basis not to close the schools*). This announcement caused protests among school representatives and society at large and ultimately changed the government's stance on this position. They made clear that in this case, the will of the people had to prevail, even if that meant that valid advice could not be followed (March 20th: *And I think the situation regarding education is that society corrected us and said, we don't agree with you. Scientifically it may be correct, but it feels different. We close anyway*). Note how, while it was the scientific reasoning that people questioned, the Prime Minister made a dedicated distinction between the scientific validity of keeping schools open and the emotional will of the people to want them closed.

The framing of uncertainty changed in light of the emerging disagreement between experts concerning the added value of using face masks in public spaces. On April 17th and May 1st, the Prime Minister referred to the uncertainty of expert advice, when questioned about increasing the use of face masks as a preventive measure (May 1st: *the problem is, the face masks, that has already*

been explained of course, is that it, it's not black or white; we just talked about the face masks, then you see that they take a little more time, which is fine, because it is not all black or white or plus or minus, there are trade-offs). In defending the delayed decision on the matter, the Prime Minister explained that experts are still in doubt about the added value of face masks, conceding uncertainty regarding the advice. It was further argued that face masks are no alternative to what experts consider the safest behavior: keeping one and a half meters distance to others (April 17th: *It is not an alternative to the meter and a half. The meter and a half, all the experts tell us, is really the safest. That is really the safest*). While the government's stance on face masks remained unchanged by the second week of May, the certainty about the uncertainty surrounding this issue was in itself described as a basis for inactivity (May 8th: *no, of course, in life there are rarely 100 per cent hard facts, but you have to base yourself on what you know, and even if you don't know something, that's a fact too*).

During our sampling period, the scientific status of certainty was constantly negotiated as to fit the ends for which this (un)certainly was deployed, consciously or not. Scientific evidence was presented throughout as the clear-cut and untouchable basis for decision-making, even if the evidence itself was considered *not* certain or found inconclusive by citizens. The many acknowledgments of uncertainty were used to suggest that government decision-making was carried out with due care, by transcending black and white thinking, or by presenting it as a bad excuse for not acting. Paradoxically, uncertainty was also used for justifying inaction in the case of face masks, and to encourage *more* action in the case of social distancing, as this was treated as the most "certain" of all other possible measures.

Twitter: There Is No Logic to These Policies. Turning the Government Into a Whimsical Actor

The notion of scientific evidence as the indisputable and clearly defined basis for policy making, is challenged in a variety of Tweets during the whole sampling period. On Twitter, expert advice and resulting policies were continually re-evaluated in the light of prior decisions and the ambiguous circumstances of everyday life, functioning as a reminder that expert advice can only be meaningful if it accounts for a complex social reality, and if it is seen as consistently applied within that reality. If the measures stemmed *directly* from the evidence available, why then apply (strict) measures in one area and not the other? For instance, when the government declared the situation highly unpredictable due to foreign introductions of the virus, the question arose as to why flights from high-risk countries had not yet been canceled when strict measures were in place in similar areas (Tweet 6).

6) 16,820 followers 121.6 influence 113 comments

Why are flights from seriously infected countries such as Iran and Italy still allowed to land in NL? Now that the RIVM

mentions the introduction of viruses from other countries as one of the reasons for the new measures? #pressconference #coronavirusNL.

7) 965 followers 17.3 influence 42 comments

Soooo ... #RIVM says that the chance that children will transmit the virus to adults is almost nil, but the question whether grandchildren can now visit grandpa and grandma was answered in the negative because of the risk of infection!!! Pretty strange #pressconference.

8) 15,486 followers 134.0 influence 134 comments

#pressconference So #Rutte and Co. follow (hide behind) the advice of Jaap van Dissel of #RIVM and say that it is safe for teachers and parents to open the schools, but the same children, who do not transmit the virus, are still absolutely not allowed to go to grandpa and grandma ...

In a similar case, the Prime Minister announced that experts advised that closing the schools would not be necessary because children would not play a major role in the transmission of the coronavirus. This decision caused disbelief among parents because grandparents were simultaneously discouraged from seeing their grandchildren. Tweeps pointed out how these measures appeared to be in clear conflict with each other, hinting there was probably something wrong with the evidence and reasoning underlying the measures (Tweets 7 and 8). This sparked a social debate that quickly led to the decision to close schools after all, not because the science was wrong but because of the contrast with how people “felt” about this measure (see governmental framing above). Similar reactions can be found regarding the government’s tenacity that one and a half meters distance in public spaces is enough to mitigate the spread of the disease. People countered that in many situations, physical distancing rules are not or cannot be adhered to (Tweets 9 and 10).

9) 2,061 followers 8.1 influence 129 comments

Please stop that nonsense about that 1.5 m distance?! I walk through the supermarket where I inhale everyone’s breath meters (!) away, because all air blowers and air conditioners are running at full power. @[Mark Rutte, Prime Minister] @[Hugo de Jonge, Minister of health] @rivm. #speech #coronameasures #pressconference.

10) 33 followers 1.2 influence 9 comments

Ordered online at a hardware store, agreed on a pick-up time, came alone ...I see there a chaos in the parking lot including plant market, families with children, older couples, pansy hoarders and no 1.5 m, and supervision only in the shop @rivm #pressconference #coronavirusNederland.

These examples show that Tweeps reject the suggestion of a logical line between the scientific evidence on the one hand, and COVID19-policies on the other. If the line is so direct as claimed, why does the same evidence yield strict measures in one case,

which are then declared inapplicable in a different but comparable case? They also signal a sharp contrast between the claimed unambiguity of the measure and the lack of government understanding of the messy day-to-day practice. By calling out these inconsistencies, people hold policymakers accountable for their seemingly incompatible decisions. Substantiation for this claim can be found in Tweets 8 and 11, in which politicians are being accused of hiding behind experts and their advice. These accusations orient to the norm that it is politicians, not experts, who ultimately make the decisions and who should be held accountable. Accountability in this context refers to the ability of policymakers to engage in deliberation with citizens, especially in situations that are marked by a high level of (also social) uncertainty and multiple paths forward. Since uncertainty was never acknowledged in this broader way, Tweeps treated the governmental references to uncertainty as lip service, allowing the government to hide behind expert advice.

11) 2,353 followers 31.6 influence 17 comments

Hugo de Jonge emphasizes that the cabinet is hiding behind the advice of experts. #corona #pressconference #rivm.

Press Conferences: While Embedded in Politics, Fact Still Speak for Themselves

On April 7th, a reporter asked whether advice from the OMT is sacred, upon which the Prime Minister responded with a sole, decisive “yes”. The question did not come out of the blue but was a result of the government’s overt dependence on expert advice, leaving commentators wonder about who truly is in charge during the crisis. The primacy of science was strengthened on various other occasions during press conferences (March 12th: *ultimately it is very crucial that expert advice is at the basis of these measures*). In a particularly remarkable example, the Prime Minister explicated that lengthy discussion about policy alternatives are rendered unnecessary when one can also rely on expert advice (March 9th: *It is very wise to follow that advice. And then I understand that some people say: yes, but shouldn’t you go further or this or that. And it applies every time: no, we build upon that advice*). That this was more than just political talk became clear when primary schools were made the first institutions to reopen after the partial lockdown. The rationale for this decision was not that the will of the people had changed, but that new evidence reaffirmed that children do not play a major role in the spread of coronavirus (April 21st: *We now know a lot more of course. The RIVM is now also conducting research in the Netherlands itself. That was also one of the commitments we made after that weekend when the schools closed*). Thus, where previously “the will of the people” had been prioritized above expert advice, a month’s worth of research turned the tables again.

The government noticed early on that this mode of decision-making, wherein a small group of experts appear to dictate the course of action, is a problematic arrangement and emphasized that all advice was evaluated in the light of political considerations (March 12th: *where of course we build upon the advice of experts, that we do not adopt*

blindly, as is sometimes assumed or that we don't have our own opinion). However, even the Prime Minister had to concede that OMT advice is usually complied with (April 7th: *Of course, we always have a political administrative discussion about this. But up to now we have actually always adopted the OMT advice afterward*). However, this political context was only identified in general terms, without demonstrating and publicly analyzing the boundary work between politics and evidence in practice, and in actual detail.

Accordingly, virtually no deliberation about how specific scientific insights may rank one policy alternative over the other, was staged in the public sphere. Instead, it was suggested that facts speak for themselves and, as experts deliver these facts, it would be foolish not to follow them.

Twitter: When Stated That Facts Speak for Themselves, we Suspect Something Else: Identifying the Government as an Interest-Driven Actor

The strong focus on expert advice combined with the dedication to quickly reopen schools gave Tweeps reason to believe that the government was pursuing a hidden agenda. Specifically, parents were concerned that what was truly behind this decision, was a covert attempt to strive for herd immunity (Tweets 12 and 13), a concept that had caused lots of commotion in mid-March already.

12) 13,869 followers 336.1 influence 159 comments

#pressconference About that face masks affair: could it be that Rutte and @rivm still aim for #herdimmunity despite all the warnings? I get suspicious of that twisting and lack of action.

13) 408 followers 25.7 influence 3,379 comments

@[Geert Wilders, opposition party leader] #herdimmunity still the plan. Now via children at school and day-care, who infect the parents, who "hopefully" also have mild complaints, says member OMT at #jinek at odds with what Van Dissel said in press conference! #closeschools.

[Comment to post above]

WTF! So #herd immunity after all, even via children in school or day-care, "hopefully the parents will have mild complaints" she literally says. Our kids are guinea pigs!

@rivm @[Hugo de Jonge, Minister of health] @[Mark Rutte, Prime Minister] explain this!

Next to schools, the second big controversy revolved around the use of face masks in public spaces. While the reason put forward by the RIVM and the government was that the masks' added value was very questionable, Tweeps suspected that in reality, there was a shortage of facemasks and that they had to be spared for healthcare workers (Tweets 14 and 15). The fact that

policymakers could simply claim ignorance and refer to their status as non-experts whenever faced with uncomfortable questions (Tweet 15), was seen as another sign of them hiding behind experts (Tweet 11). The novelty of the current framing when compared to the second framing, is that policymakers and experts are now portrayed as conspiring together in the pursuit of dubious goals. Thus, the heavy reliance on expert advice is treated as a way to bypass public discussion about policy alternatives (Tweet 16). To many Tweeps, this behavior only made sense if the government had an interest in undermining dissent in order to follow their hidden agenda. In their response, they show that they are neither naive nor stupid, by uncovering concealed motives the government or OMT may have.

14) 3,898 followers 202.9 influence 487 comments

In the press conference, De Jonge finally admits it after follow-up questions about face masks for Dutch citizens. "The experts also advise with scarcity in mind of course". In plain Dutch "we do not recommend masks, otherwise we admit that we cannot arrange that either".

15) 1,119 followers 93.1 influence 366 comments

Question to Hugo de Jonge during the #pressconference: "Belgium and Germany strongly advise to wear face masks, why not the Netherlands?" De Jonge: "I don't know, I follow the experts, and healthcare professionals really need them." We now know that they are simply not there.

16) 27,059 followers 224.7 influence 1,589 comments

Cabinet refuses to disclose corona crisis documents after WOB⁶ requests, until they become irrelevant <https://t.co/lfvUjBOSaX> Thus a Minister with a handful of experts will run the country without sharing the information.. Scandalous! #pressconference #coronameasures <https://t.co/bGIQv8v8vB>.

[Comment to post above]

Corona policy has major consequences for democracy, fundamental rights, the economy and the social life of people. There was never any significant discussion about alternatives .. #Coronavirusnl Sign for a parliamentary inquiry on corona policy! <https://t.co/bgHgZ670ni>.

Again, the overall framing on Twitter did not deny the importance of expertise in decision making as such but criticized the government for withholding information from the public, thereby failing to be honest and fair in their decision-making processes.

DISCUSSION

The COVID crisis took the Dutch government by surprise. By implication, the initial response had the character of an

⁶Refers to the Open Government Act (Wet Openbaarheid van Bestuur: WOB).

“impromptus” performance. Yet any choice in terms of staging yourself as government is a particular “enactment” of authority and thus comes with consequences. The performance as found in the first phase of the pandemic fits the classical “science-for-policy” formula (cf. Van Dijck and Alinejad, 2020). It goes back to the formulation of Aaron Wildavsky (1979) who introduced it as the “speaking truth to power” format. According to this positivist approach, the legitimacy of political choice is backed up by expert advice, in which experts come to policy suggestions based on the best available scientific advice. Typically, the expert here draws on classical sources of knowledge, based on Humean general laws. This type of knowledge, found in the scientific literature, has a particular standing as it is seen as codified by the practices of science such as peer-review. It brings out universal laws that are argued to be culturally neutral and objective (cf. Hajer et al., 2009). Furthermore, essential in technocratic governance such as this is that facts, data and information are expected to resolve possible conflicts (Fischer, 1990: 28), and that they are visibly and clearly distinguishable from values or politics, also with a view to their public accountability.

However, the resolving of COVID-related conflicts and building of strong truth regimes (Jasanoff and Simmet, 2017) cannot be achieved by addressing facts only. Or as political scientist (Fischer, 2019, p. 135) puts it: “fact-checking or the discovery of more and better facts will not put this controversy to rest.” What is needed is the addressing of moralities and the institutional arrangements that make those facts *relevant* and *possible*. While many scholars would agree, few approaches actually reveal these moralities, and virtually no approaches can surface them unless they are explicitly available. We hope to have shown that our analysis was able to do so.

We demonstrated that in their responses to government policies, Dutch Tweeps not only -or not so much-disputed the scientific evidence brought up, but especially their *moral relationships with government, politics and experts*, including the government’s alleged complacency while asking citizens to blindly trust, their unpredictable behavior in the light of the promised straight line between scientific evidence and policy making, and the invested behavior they showed, while claiming that “facts speak for themselves”.

Interestingly, “uncertain” knowledge was drawn upon by the Dutch government in their press conferences, both to account for *action* (we cannot but act, even in the light of uncertain knowledge), and to account for *inaction* (we do not recommend face masks in the face of inconclusive evidence). Perhaps the most striking result was that while Tweeps accused the government of inconsistent policies, by indirectly contrasting these policies with the straight line between evidence and policy making that the government had promised, none of the responses called into question the underlying technocratic model itself. That is, there was no disputing of the value and position of scientific expertise itself for the making of these policies, other than referrals to alternative scientific positions than the cherished virologists and epidemiologists represented.

Note that this is the case and seems characteristic for at least the early period of the COVID crisis that we studied. Our analysis is confined to the Dutch situation in the Spring of 2020 and

cannot be automatically extrapolated to other countries or periods. As Jasanoff (2005) demonstrates, nation-states may vary in their “civic epistemologies”, that is, their own cultural ways of public knowledge-making and resolving disputes around data and evidence. Nor can it be ruled out that the Dutch government deployed other knowledge-political repertoires in the later stages of the crisis, which subsequently provoked different reactions. However, first impressions of changing relationships between science and politics can easily be deceiving. As we have shown, in this first period of the pandemic, the underlying technocratic model remained unchanged, even when there was talk of opening up the debate to non-experts and citizens (in what Van Dijck and Alinejad (2020) call the “smart exit phase”).

An important element of the dramaturgy of the “intelligent lockdown” was the coupling of the political leader (Rutte) to the prime expert (Van Dissel). While this makes sense for a media savvy politician like Prime Minister Rutte, it creates a tension with the traditional “science-for-policy” format in which scientific expertise is often seen as an *institutional* resource. Yet the press conference, and the personal communication of the Prime Minister in the first weeks created an explicit personalization of expertise. In his first speech he named “Jaap van Dissel” as the leading expert. Staging expertise in a person inadvertently loosened up Jaap van Dissel as a person from his position as one of the directors of the National Institute for Public Health and the Environment (RIVM). Following the media-format, it was the *person* of Van Dissel who was taken on in the social media critique, not the institutional powerhouse of the RIVM he represented. In the end this conscious and insistent “staging” of the Prime Minister and the director of the RIVM as a “pair”, created a personalization of the institutional expertise of RIVM. In that case the authority comes to be dependent on a mix of the institutional reputation and the personal style of its spokesperson. As Dick Pels observed, a long time ago: “Increasingly, positions of political power are dependent upon public trust, belief and confidence (and upon those who are able to manipulate these volatile variables), and hence upon a recognizable political style that weaves together matter and manner, principle and presentation, in an attractively coherent and credible political performance” (Pels, 2003, p. 57).

So, while putting the expert Van Dissel on stage may have helped the politician Rutte in supporting his choice with a scientific basis following the “science for policy” format, the choice to communicate via press conferences may have created a feeling of an expert that is aloof and distant. This is the more plausible as Van Dissel himself constantly used the “science for policy” format with insistence on finding his scientific authority in referring to the peer-reviewed literature, as for instance in the cases of school openings or closures or the wearing of face masks or not. If Van Dissel would have employed a different, dialogical model, he would have shown himself to be open to the knowledge of teachers or people operating in contexts in which face masks may seemingly have had an effect.

The weekly press conferences functioned as a clear orientation point for the critique on social media, most notably Twitter. In that context one cannot assume a shared knowledge of the way in

which the science-policy interface is organized. Hence, that what is uttered in the context of the press conference becomes the lead for interpreting how policy making is organized. Here the complex layering of organisations - each with its own acronym (RIVM, OMT, Van Dissel as chair of the OMT—as a council of specialists spread over various organisations, Van Dissel as director of RIVM), reinforces the suggestion of a hidden technocracy.

There was always a complexity in the performance of Jaap van Dissel as the sole spokesperson of the science. On the one hand the Prime Minister could “simply” refer to him to speak for the science, on the other hand Van Dissel had to share what he and his council (the OMT) had agreed upon. It is interesting to note that the OMT had decided that their internal deliberations and decision-making moments were not transcribed and that the meeting were not supported by minutes that were publicly accessible. While we can only guess, this may have been because of the alleged undermining of the authority of the science should people be able to “listen in” on the arguments among scientist experts. Yet, there is reason to doubt whether that effect would indeed have taken place. The critique we now found on Twitter, suggesting that the Dutch government was operating in a sphere of secrecy and elitism, could have been effectively combated in this way.

Unwittingly, the Dutch staging of science in terms of one key person and keeping the broader deliberation in the OMT from the public eye, opened the gate to suggest that secrecy was necessary, because something had to be kept hidden. The fact that it remained undisclosed on the basis of what science measures such as halting public transport or restrictions on outdoor gatherings were taken, fed the sense that it was not science but politics that was dominant.

The dramaturgy of the press conference was that of the classic “speaking truth to power”, with an expert staged as advisor to politics. In this classic model (Wildavsky, 1979), it is the politician that is to do the weighing of pros and cons based on hearing the evidence. But what is remarkable in the Dutch case is that the weighing of evidence, of pros and cons, was suggested to be *outside* the event of the press conference. The OMT was a primarily *medical* council and to the extent that social scientists were involved it was to come to an assessment of the effects of policy measures on fighting COVID. Yet the deeper choices, whether the measures were proportional vis-à-vis other (side)effects, e.g., on personal freedom or economic and social well-being, were not part of the publicly presented weighing of the evidence. That these are political rather than scientific considerations, has been repeatedly put forward by OMT members.

Interesting about the dramaturgy of the Dutch “intelligent” lockdown is that we have seen a *proto-professionalization* as the critics imply that if they had seen any convincing scientific evidence, they might have been persuaded. Moreover, we see how antagonists criticize government for rigid measures following scientific advice, but use scientific “facts” in their argumentation, hence take up the language that they see belonging to the performance of which they see themselves a part. This proto-professionalization also comes out in the insistent epidemiological and virological frames with key

words like “flattening the curve” “patient zero”, and the “reproduction number R_0 ”. It pushes out “common concerns”, just like the insistence of the OMT to keep schools open, as there was no evidence in the peer-reviewed scientific literature that school children contributed to the pandemic.

All in all, it was not politics and values that threatened the robustness of (the scientific evidence that underpinned) corona policymaking and measures. Scientific expertise is treated as credible and institutionally legitimate, *precisely because* the underlying values are openly and appropriately addressed. Building a robust factual basis for decision-making in modern society therefore requires a fundamental shift from a “Let-me-explain-it-once-more” repertoire and classical “science-for-policy” dramaturgy, to a sustained dialogue in which the interplay between morality and science can be openly examined, questioned and discussed. The notion that such an approach might lead to the marginalization, or even dissolution of “substantive expertise”, is misguided, as we cannot “wish away” that moralities *together with* facts decide whether society accepts policy truths *as* truths.

The boundary between science and values is diffuse but this does not absolve us of the responsibility to discuss these boundaries and open them up to dialogue. Other than “debate”, which is aimed at stating differences, dialogue surfaces and critically reflects on underlying moralities (Scharmer, 2016; Van Burgsteden et al., 2021) by inquiry and “thinking together”. It is good to realize that the science/politics border is negotiated in all kinds of ways, by all kinds of actors, and at all times. Negotiations range from determining the status of the overall scientific evidence on a specific theme (“contradictory” or “inadequate” in the case of the face masks), to stating that with 50% of the knowledge, we should make 100% of the decisions. Transparency in this area, including the struggle with the demarcation of facts and values, is an essential pillar for a reliable government policy, and a reliable role of advisory councils and knowledge institutions in this regard.

Citizens must be able to participate actively in this process, but we must be careful not to blackmail them with this participation (an active contribution is mandatory, otherwise you lose your right to participate). Or as the Dutch writer Remco Campert once said: “I myself was approached on the street by someone who asked me if I was a citizen. I just denied it to get rid of him.” The desired participation options would be sustainable but also flexible and diverse in form. In addition to stakeholder participation and citizen consultation, we should also consider increasing the learning capacity of the government itself, so that it can quickly enter into a dialogue with changing coalitions of citizens, at moments that are difficult or impossible to anticipate.

The shift from debate, which creates winners and losers on the basis of the exchange (and presupposition) of points of view, to dialogue, which brings hidden assumptions to the surface to make them negotiable, is essential here. Above all, it requires the courage “to talk morality” in a world dominated by “fact-talk”, and the commitment to constantly take seriously those who criticize a position as expressed by the powerful. So, authority is not derived from the institutional origin of the argument (e.g., the OMT), but is to be constantly and repeatedly enacted. It is also

an approach that does not depend on a staging of authority but derives its authority much more from its open response to critics. The openness of this model is expressed in its willingness to take into account other non-scientific “ways of knowing” (Schneider and Ingram, 2007). Those situated understandings can often help explain why a universal knowledge claim does not work in a particular situation. Allowing those other sources of knowledge in may feel risky as it effectively means surrendering the sole authority of knowledge. Yet, if done well, this dialogue model can be very effective in building good, sustainable and truly democratic relationships.

DATA AVAILABILITY STATEMENT

The anonymized, raw data supporting the conclusion of this article can be made available upon request.

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ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Written informed consent was not obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

RV and RP conducted the data collection, MH drafted the discussion and HM edited the final draft. All authors contributed to the study design and data analysis.

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Scientific Literacy Linked to Attitudes Toward COVID-19 Vaccinations: A Pre-Registered Study

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The ongoing COVID-19 pandemic, which began in early 2020, is a global public health crisis. To prevent the spread of COVID-19, it is necessary to promote vaccine administration and preventive behaviors (e.g., mask, handwashing, social distancing). However, some people have negative attitudes toward vaccine administration and preventive behaviors. Based on the information-deficit model, the present study investigated how scientific literacy and perceived understanding of COVID-19 are associated with attitudes toward COVID-19 vaccinations and preventive behaviors. The findings demonstrated that both scientific literacy and perceived understanding of COVID-19 vaccines were positively associated with attitudes toward COVID-19 vaccines. Additionally, perceived understanding of COVID-19 preventive behaviors (but not scientific literacy) was positively associated with attitudes toward/practice of COVID-19 preventive behaviors. Collectively, our findings revealed the role of cognitive factors in preventing the global public health crisis and demonstrated the roles of objective and subjective knowledge on attitudes toward COVID-19 vaccinations and preventive behaviors.

Keywords: COVID-19, scientific literacy, vaccines, preventive behaviors, attitudes, objective knowledge about science

INTRODUCTION

The COVID-19 pandemic is a global public health crisis. In December 2019, SARS-CoV-2 emerged in Wuhan, China. Following this, the virus spread around the world and has now killed millions of people (Rodríguez Mega, 2020). To prevent the spread of COVID-19, it is crucial to promote vaccine administration and preventive behaviors (e.g., mask, handwashing, social distancing). However, the rate of some of preventive behaviors is still less than optimal (Azlan et al., 2020; He et al., 2021) and a certain percentage of people are reluctant to get vaccinated. A global survey across 19 countries has indicated that 14.2% of respondents are reluctant to accept a COVID-19 vaccine even if it is generally available (Lazarus et al., 2021). It has also been reported that 25.9% of respondents are reluctant to accept a COVID-19 vaccine on their employer's recommendation (Lazarus et al., 2021). Given considerable variation of attitudes toward the vaccinations and preventive behaviors, it is important to gauge the factors underlying these individual differences.

Information-Deficit Model

The information-deficit model is a theoretical framework for science communication including attitudes toward COVID-19 vaccines and preventive behavior (Ransing et al., 2021). The

information-deficit model assumes that the public is rational, and it also suggests that hesitancy of vaccines/preventive behaviors might be due to insufficient scientific knowledge (Ransing et al., 2021). It should be noted that this model has been criticized (see Smith, 2017). One study has shown that providing scientific knowledge to people does not always increase vaccination acceptance (Sadaf et al., 2013). However, in terms of attitudes toward COVID-19 vaccines/preventive behavior, there have been some findings consistent with the information deficit model.

Factors Associated With COVID-19 Vaccine Attitudes

Previous research has revealed that factors associated with scientific knowledge are linked with COVID-19 vaccine attitudes (e.g., Petravić et al., 2021; Robertson et al., 2021; Sturgis et al., 2021). Educational levels were associated with COVID-19 vaccine refusal/hesitancy (Petravić et al., 2021; Robertson et al., 2021; Schwarzsinger et al., 2021). Those with higher (vs. lower) educational levels tend to be less hesitant to COVID-19 vaccinations (Petravić et al., 2021; Robertson et al., 2021; Schwarzsinger et al., 2021). Furthermore, it has been shown that psychological factors such as trust in the vaccine safety (Karlsson et al., 2021), trust in science (Sturgis et al., 2021), and perceived vaccine safety (Karlsson et al., 2021) are positively associated with vaccination intentions or confidence about vaccination. Additionally, cognitive factors including higher analytical reasoning skills (Murphy et al., 2021), higher scientific reasoning skills (ability to understand statistical information such as “causation vs. correlation”) (Čavojová et al., 2020), and higher cognitive functions (measured by diverse cognitive tests including verbal declarative memory) (Batty et al., 2021) were associated with positive attitudes toward COVID-19 vaccination. These findings suggest that scientific knowledge might relate to COVID-19 vaccine attitudes.

Factors Associated With Attitudes Toward/Practice of COVID-19 Preventive Behaviors

A growing body of evidence has also revealed that factors associated with scientific knowledge have influenced on attitudes toward/practice of COVID-19 preventive behaviors (e.g., Brzezinski et al., 2020; Xu and Cheng, 2021). For instance, those who have greater belief in science (Stosic et al., 2021), higher need for cognition (Xu and Cheng, 2021), and higher self-control (Xu and Cheng, 2021) reported frequent mask-wearing behavior during the pandemic. Furthermore, those who have a higher need for cognition (Xu and Cheng, 2021), higher self-control (Xu and Cheng, 2021), and higher working memory capacity (Xie et al., 2020) were more likely to follow social distancing during the COVID-19 pandemic. Moreover, recent research has shown that anti-intellectualism (distrust of experts and intellectuals) is associated with less mask usage and social distancing (Merkley and Loewen, 2021). Given these findings, it might be suggested that scientific knowledge relates to attitudes toward COVID-19 preventive behaviors.

The Role of Scientific Literacy as Objective Knowledge of Science

Based on the information-deficit model, the present study investigated the role of scientific literacy on attitudes toward COVID-19 vaccines and preventive behaviors. Scientific literacy is a cognitive factor depicting objective knowledge of science (Fernbach et al., 2019), though there have been debates on the precise definition (Miller, 1983). The information-deficit model assumes that a lack of scientific literacy contributes to negative attitudes toward science (e.g., Bak, 2001). Relevant to the present study, a line of research has shown that scientific literacy is associated with attitudes toward biotechnology-related topics (Rutjens et al., 2018; Fernbach et al., 2019; McPhetres et al., 2019). For example, those who have lower scores on scientific literacy tend to show negative attitudes toward vaccines (Rutjens et al., 2018). Although the importance of scientific literacy in the era of COVID-19 has been suggested (Fotou and Constantinou, 2020), little is known about how scientific literacy associates with attitudes toward COVID-19 vaccines and preventive behaviors. With this in mind, the present study investigated how scientific literacy relates to attitudes toward COVID-19 vaccines and preventive behaviors.

METHODS

Participants

A total of 500 Japanese participated in an online survey in exchange for 100 JPY. The participants were recruited on Crowdfunder (<https://crowdfunder.jp/>) and they completed the survey on Qualtrics (<https://www.qualtrics.com/jp/>). A priori power analyses using G*power (Faul et al., 2007) indicates that 451 participants would be sufficient to detect a small effect size ($f^2 = 0.02$) with 85% power at an alpha level of 0.05. Given the possibility that some of participants would fail the attention check, we collected data from 500 participants. No participants failed the attention check and the final data collected included all 500 participants (296 males, 196 females, 8 prefer not to say, mean age of 39.30, SD = 9.99). The data were collected in April 2021, the critical period when COVID-19 vaccines are scheduled to become available to the general public in Japan. Studies described herein were approved by the ethics committee of School of Medicine Tohoku University and were conducted in accordance with the Declaration of Helsinki. Our study was pre-registered on AsPredicted.org (#63121).

Measures

Scientific Literacy

The degree of scientific literacy was measured by objective knowledge about science (Fernbach et al., 2019). Participants asked 15 true–false questions on scientific literacy (e.g., “Electrons are smaller than atoms”) adapted from Fernbach et al. (2019). The questions are based on a 7-point scale anchored by “definitely true” and “definitely false.” We calculated –3 to 3 points depending on the correctness. For example, we calculated 3 points (–3 points) when a participant chose “definitely true” and the correct answer was

“true” (“false”). The total points across all questions were regarded as the measure of scientific literacy (Fernbach et al., 2019). All questions are provided in Appendix A.

Perceived Understanding of COVID-19 Vaccines and Preventive Behaviors

The perceived understanding of COVID-19 vaccines and preventive behaviors were measured, respectively. Participants read the instructions on how to evaluate their levels of perceived understanding. The instructions were the same as previous literature on genetically modified foods (Fernbach et al., 2019) and are shown in Appendix B. Next, the participants rated their perceived understanding of COVID-19 vaccines and preventive behaviors, respectively on a single item of a 7-point scale anchored by “vague understanding” and “thorough understanding”.

Attitudes Toward COVID-19 Vaccines

Attitudes toward COVID-19 vaccines were measured by three items. Participants answered their COVID-19 vaccine intention, trust in COVID-19 vaccines, and perceived efficacy of COVID-19 vaccines on a 7-point Likert scale (1 = not at all, 7 = very much). The mean ratings of three items were used as an indicator of attitudes toward COVID-19 vaccines ($\alpha = 0.875$). A higher score indicates greater positive attitudes toward COVID-19 vaccines.

Attitudes Toward COVID-19 Preventive Behaviors

Attitudes toward COVID-19 preventive behaviors were measured by three items. Participants answered their belief about the efficacy of COVID-19 preventive behavior (mask use, hand wash, and three Cs¹) on a 7-point Likert scale (1 = not at all, 7 = very much). The mean ratings of their beliefs about the efficacy of COVID-19 were used as indicators of attitudes toward COVID-19 preventive behaviors ($\alpha = 0.788$). A higher score indicates more positive attitudes toward COVID-19 preventive behaviors.

Practice of COVID-19 Preventive Behaviors

The practice of COVID-19 preventive behaviors was measured by three items. Participants answered their daily frequency of COVID-19 preventive behaviors (mask use, hand wash, and three Cs) on a 7-point Likert scale (1 = not at all, 7 = very much). The mean ratings of three items were regarded as an indicator of practice of COVID-19 preventive behaviors ($\alpha = 0.740$). A higher score indicates more frequent practices of COVID-19 preventive behaviors.

The Fear of COVID-19 Scale

The Japanese version (Wakashima et al., 2020) of the Fear of COVID-19 scale (Ahorsu et al., 2020) was collected. The scale includes 7-items and one factor. The scale indicated adequate

TABLE 1 | Demographic information of the participants.

Demographic variable	Value
Age	
Mean (SD)	39.29 (9.99)
Min-Max	18–74
Gender (%)	
Male	39.2
Female	59.2
Unanswered	1.6
Education (%)	
Below high school diploma	2.2
High school diploma	20.6
Vocational	20.4
Bachelor's Degree	54.2
Master's Degree	2.6
Underlying condition (%)	
Yes	8.4
No	91.6

Note. $n = 500$.

internal reliability ($\alpha = 0.87$; $\omega = 0.92$) (Wakashima et al., 2020). Participants rated each item on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). The total score was used for analyses, with a higher score indicating greater fear of COVID-19.

Survey Procedure

First, participants answered questions on two blocks (subjective knowledge about COVID-19 vaccines and preventive behaviors, scientific literacy). The order of blocks and items within blocks were randomized. Next, participants indicated their attitudes toward COVID-19 vaccines and their attitudes toward/practice of COVID-19 preventive behaviors. The order of questions (attitudes toward COVID-19 vaccines, attitudes toward and practices of COVID-19 preventive behaviors) were randomized. The items within the questions were also randomized. Finally, participants answered the Japanese version of the Fear of COVID-19 scale (Wakashima et al., 2020), their demographic information (gender, age, educational level), and whether or not they have underlying disease(s).

Statistical Analysis

We conducted regression analyses (ordinary least squares: OLS) to investigate how 1) scientific literacy relates to attitudes toward COVID-19 vaccines; 2) scientific literacy relates to attitude toward/practice of COVID-19 preventive behaviors; 3) perceived understanding of COVID-19 vaccines relates to attitudes toward COVID-19 vaccines; 4) perceived understanding of COVID-19 preventive behaviors relates to attitudes toward/practice of COVID-19 preventive behaviors. Additionally, by adding education level as a covariate, we conducted multiple regression analyses.

We also conducted regression analyses to investigate the role of gaps between scientific literacy and perceived understanding of COVID-19 vaccines and preventive behaviors. The gaps were calculated by subtracting the (z-scored) scientific literacy from the (z-scored) perceived

¹The 3Cs is a slogan coined by the Japanese government in 2020 for warning people to avoid three factors of cluster infection. The 3Cs stands for Closed spaces with poor ventilation, Crowded places with many people nearby, and Close-contact settings such as close-range conversations.

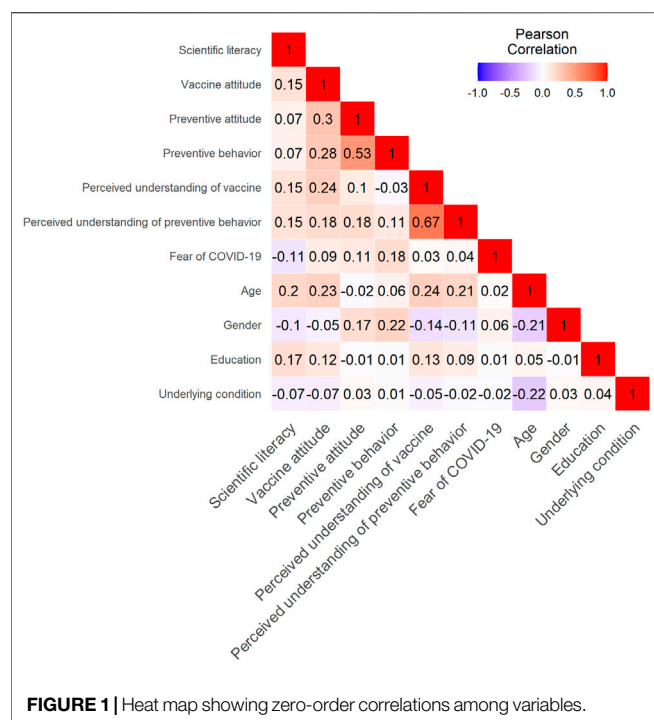


FIGURE 1 | Heat map showing zero-order correlations among variables.

understanding. Specifically, we conducted the following regression analyses: 1) the role of the gaps on attitudes toward COVID-19 vaccines; 2) the role of the gaps on attitudes toward/practice of COVID-19 preventive behaviors. These analyses did not yield significant results (Supplementary Table S1) and are not discussed further.

RESULTS

Demographic information of the participants is shown in Table 1. The zero-order correlations of variables are presented in Figure 1. The results of regression analysis indicated that scientific literacy was positively associated with attitudes toward COVID-19 vaccines (Table 2). In contrast, scientific literacy did not relate to attitudes toward/practice of COVID-19 preventive behaviors. The results also indicated that perceived knowledge of COVID-19 vaccines was positively

correlated with attitudes toward COVID-19 vaccines. Similarly, perceived knowledge of COVID-19 preventive behavior was positively associated with attitudes toward and practice of COVID-19 preventive behaviors. Visual illustrations of the main findings are shown in Figure 2.

It is possible that educational levels influence our main findings. In other words, the relations between scientific literacy and attitudes toward COVID-19 vaccines might reflect education levels. To test this possibility, we re-ran the main analyses including education level as a covariate. The results of additional analyses demonstrated that the key findings remain significant after controlling educational level (Table 3).

Given the above findings, it might be possible that scientific literacy relates to perceived understanding of COVID-19 vaccines, which in turn affect attitudes toward COVID-19 vaccines. For exploratory purposes, we conducted a mediation analysis using the PROCESS macro for SPSS (Hayes, 2013) with 5,000 bootstrap samples. In this analysis, we entered scientific literacy as the independent variable (X), attitudes toward COVID-19 vaccines as the outcome variable (Y), perceived understanding of COVID-19 vaccines as the mediator variable (M). If the 95% bias-corrected confidence intervals did not include zero, we regarded them as significant (Preacher and Hayes, 2004).

The results demonstrated that perceived understanding of COVID-19 vaccines partially mediated the relations between scientific literacy and attitudes toward COVID-19 vaccines (Figure 3). That is, participants with scientific literacy may have more perceived understanding of COVID-19 vaccines and subsequently have more positive attitudes toward COVID-19 vaccines.

DISCUSSION

The present study investigated how scientific literacy and perceived understanding of COVID-19 are associated with attitudes toward COVID-19 vaccines and preventive behaviors. The findings demonstrated that both scientific literacy and perceived understanding of COVID-19 vaccines are positively associated with attitudes toward COVID-19 vaccines. Additionally, perceived understanding of COVID-19 preventive behaviors (but not scientific literacy) is positively associated with attitudes toward/practice of COVID-19 preventive behaviors. Collectively, these findings revealed the role of cognitive factors

TABLE 2 | Roles of scientific literacy and perceived understanding on attitudes toward vaccines and attitudes/practices of COVID-19 preventive behavior.

Dependent	Independent	β	SE	T	p	95% CI		R^2
						Lower	Upper	
COVID-19 vaccine attitudes	Scientific literacy	0.153	0.044	3.452	<0.001	0.066	0.240	0.023
	Perceived understanding of COVID-19 vaccines	0.242	0.043	5.576	<0.001	0.157	0.328	0.057
Attitudes toward COVID -19 preventive behaviors	Scientific literacy	0.070	0.045	1.563	0.119	-0.018	0.158	0.005
	Perceived understanding of COVID-19 preventive behaviors	0.184	0.044	4.174	<0.001	0.097	0.270	0.034
Practices of COVID-19 preventive behaviors	Scientific literacy	0.071	0.045	1.594	0.112	-0.017	0.159	0.005
	Perceived understanding of COVID-19 preventive behaviors	0.114	0.045	2.551	0.011	0.026	0.201	0.013

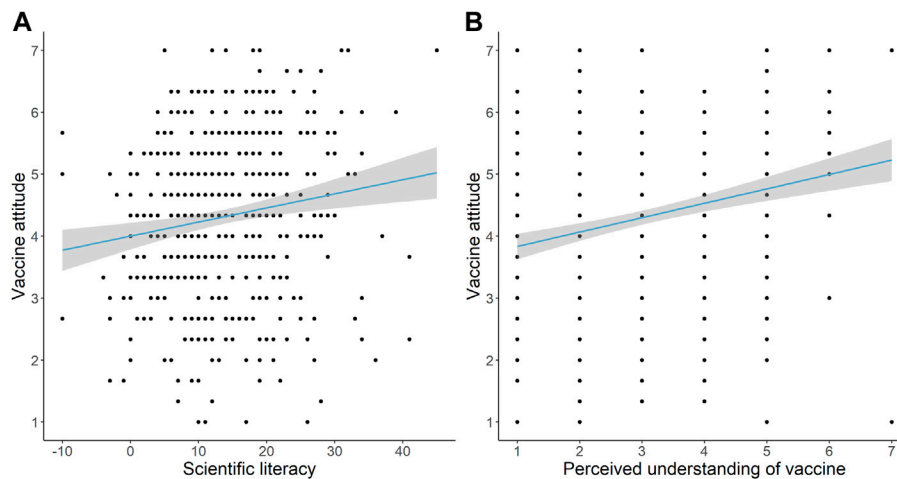


FIGURE 2 | (A) Scatterplot of the relations between scientific literacy and COVID-19 vaccine attitudes. **(B).** Scatterplot of the relations between perceived understanding of COVID-19 vaccines and COVID-19 vaccine attitudes. The solid lines represent best-fitting regression lines. The shaded areas represent the 95% confidence interval around the regression line.

TABLE 3 | Roles of scientific literacy and perceived understanding on attitudes toward vaccines and attitude/practice of COVID-19 preventive behaviors after controlling for educational level.

Dependent	Independent	β	SE	t	p	95% CI		adj. R^2
						lower	Upper	
COVID-19 vaccine attitudes	Scientific literacy	0.137	0.045	3.055	0.002	0.049	0.225	0.028
	Perceived understanding of COVID-19 vaccines	0.231	0.043	5.288	<0.001	0.145	0.317	0.062
Attitudes toward COVID -19 preventive behaviors	Scientific literacy	0.074	0.045	1.622	0.105	-0.016	0.163	0.001
	Perceived understanding of COVID-19 preventive behaviors	0.186	0.044	4.207	<0.001	0.099	0.273	0.031
Practice of COVID-19 preventive behaviors	Scientific literacy	0.072	0.045	1.585	0.114	-0.017	0.161	0.001
	Perceived understanding of COVID-19 preventive behaviors	0.114	0.045	2.543	0.011	0.026	0.202	0.009

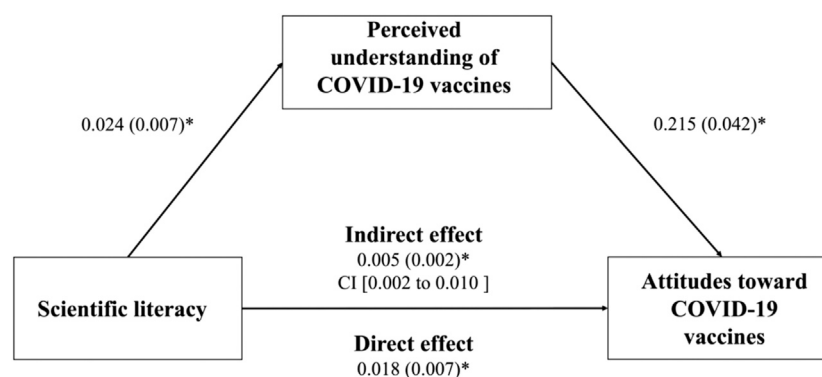


FIGURE 3 | The relations between scientific literacy and attitudes toward COVID-19 vaccines mediated by perceived understanding of COVID-19 vaccines. Unstandardized coefficients are displayed. Standard errors are represented in parentheses. * $p < 0.05$.

in preventing the global public health crisis and demonstrated the roles of objective and subjective knowledge on attitudes toward COVID-19 vaccinations and preventive behaviors.

Our findings contribute to the role of scientific literacy on public attitudes to science and technology topics. Previous research found that the role of scientific literacy on public

attitudes to science and technology issues is dependent on the type of issues (Drummond and Fischhoff, 2017; Fernbach et al., 2019). On the one hand, those with more science literacy tend to display polarized beliefs on some issues (e.g., stem cell research, human evolution) (Drummond and Fischhoff, 2017). On the other hand, those with higher science literacy tend to accept or display positive attitudes toward nanotechnology and genetically modified foods (Drummond and Fischhoff, 2017; Fernbach et al., 2019). Our findings demonstrated the positive impact of scientific literacy on attitudes to COVID-19 vaccines (but not COVID-19 preventive behaviors). These findings suggest that scientific literacy might be positively associated with topics relevant to technology (e.g., nanotechnology, genetically modified foods, COVID-19 vaccines).

Contrary to COVID-19 vaccinations, we found no significant relations between scientific literacy and attitudes toward/practice of COVID-19 preventive behaviors. The non-significant relation of scientific literacy is largely consistent with previous research (Rutjens et al., 2018; Fernbach et al., 2019). For example, Fernbach and colleagues revealed that scientific literacy was associated with attitudes toward genetically modified foods but not climate change attitudes (Fernbach et al., 2019). This suggests that scientific literacy does not always explain the attitudes to scientific or public health issues. One possible reason for the null results of attitudes toward/practice of COVID-19 preventive behaviors is baseline differences in attitudes. Our participants show more positive attitudes toward COVID-19 preventive behaviors ($M = 5.484$) than COVID-19 vaccinations ($M = 4.319$). Moreover, participants have already adopted COVID-19 preventive behaviors in their everyday life ($M = 6.262$). This might diminish the effects of scientific literacy on attitudes toward/practice of COVID-19 preventive behavior. Rather, other motives such as conformity to social norms might have prominent roles in attitudes toward/practice of COVID-19 preventive behaviors (see Nakayachi et al., 2020).

Our findings support the knowledge deficit model. The model attributes public skepticism or misunderstanding of science to a lack of knowledge (Bak, 2001). The model implies that experts should transfer their scientific communications to the general public to foster their scientific knowledge. Our findings demonstrated that both general scientific knowledge and perceived knowledge of COVID-19 vaccinations positively associate with attitudes toward COVID-19 vaccinations. Moreover, perceived understanding of COVID-19 preventive behaviors is positively associated with attitudes toward/practice of COVID-19 preventive behaviors. These findings suggest that potential campaigns and interventions aimed at increasing COVID-19 vaccinations and preventive behaviors might result in increased acceptance of COVID-19 vaccinations and preventive behaviors. Together, the present results provide partial support for the knowledge deficit model within the context of COVID-19 vaccinations and preventive behaviors.

Our data were collected in April in Japan when the vaccinations were still limited to health care workers and the general public was waiting for vaccine distribution. Recent research in Japan found that only 62.1% of respondents had a high likelihood of getting vaccinated (Machida et al., 2021). This

implies the variability of the vaccine attitudes in Japan. The present findings demonstrated that the higher levels of scientific literacy and perceived understanding of vaccines were associated with greater positive the attitude toward vaccination. Our findings might contribute to understanding the heterogeneity of the vaccine attitudes in Japan and provide useful information for the development of strategies to promote vaccine acceptance.

In a broad sense, this study aimed to find out how to stop the global epidemic of COVID-19 as quickly as possible, but at the same time, it also suggests the importance of science communication to increase scientific literacy to the general public from normal times as a role of scientists. Future work should investigate whether high scientific literacy, which supports high levels of preventive behaviors toward COVID-19 as shown in this study, is broadly related to health behaviors.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by School of Medicine Tohoku University. The patients/participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KM: Conceptualization, Formal analysis, Methodology, Writing-Original Draft, Writing-Review and Editing. TS: Conceptualization, Formal analysis, Methodology, Writing-Review and Editing. YT: Conceptualization, Methodology, Writing-Review and Editing.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fcomm.2021.707391/full#supplementary-material>

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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