

Charting cognition: Mapping public understanding of COVID-19

Public Understanding of Science

1–19

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Abstract

The COVID-19 pandemic of the last 2 years (and counting) disrupted commerce, travel, workplaces, habits, and—of course—health, the world over. This study aimed to capture snapshots of the perceptions and misperceptions of COVID-19 among 27 participants from three US municipalities. These perspectives are analyzed through thematic analyses and concept maps. Such snapshots, particularly as viewed through the lens of narrative sense-making theory, capture a sample of cognitions at this unique moment in history: a little over 1 year into the COVID-19 pandemic. Findings suggest that the (mis)perceptions captured are predominantly conveyed via narratives of participants' personal experiences, and that the themes of attitudes toward precautionary measures, uncertainty, and the muddled science communication environment are prevalent. These themes suggest several salient targets for future research and current science communication, such as a focus on basic explainers, vaccinations' safety and effectiveness and the necessity of uncertainty in the practice of science.

Keywords

health communication, public understanding of science, science attitudes and perceptions, science communication, science journalism

1. Introduction

The ongoing COVID-19 pandemic represents a momentous event in global history for its world-wide disruption of commerce, travel, work, and—of course—health. The United States is still undergoing this disruption, and it is evident not everyone perceives its root cause—COVID-19—the same. Though virology is a scientific discipline, the commentary on this viral disease has not remained the purview of science, but has become the topic of casual conversations, conspiracy theorizing, political points-scoring, and many other realms of public life (Hart et al., 2020). Many information sources have been inaccurate, unsubstantiated, or incomplete in their portrayal of

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COVID-19 (Motta et al., 2020), but it is unknown what the influence of viral misinformation has been on public understandings of this pandemic in the United States.

This study aims to investigate and catalog a sample of the perceptions of COVID-19 in three populations—a diversified sample purposively drawn from three municipalities in the United States: Lubbock, Texas; New Brunswick, New Jersey; and San Francisco, California. Public (lack of) understanding of science—and particularly science of such universal applicability to today's global landscape (viruses)—is pertinent to effects on personal and group behaviors (Bridgman et al., 2020; Gauchat, 2012; MacDonald and Holden, 2018). Consequently, this (lack of) understanding is liable to affect the way COVID-19 is addressed (or not) in communities across the country and around the world. To capture a piece of the public's perceptual landscape around COVID-19, this project endeavors to document understandings and misunderstandings of COVID-19 among our participants via thematic analysis and concept mapping of select participants' understandings of the disease.

Uncovering participants' perceptions will contribute to a greater understanding of what people in the United States know and believe about COVID-19. The sample enrolled in this study exhibited generally correct (if not always extensive) understandings, though the misunderstandings demonstrated—as well as those that participants reported were circulating among their acquaintances, friends, and family members—merit further investigation.

2. Literature review

COVID-19 pandemic

The now-familiar COVID-19 (Coronavirus Disease 2019) pandemic burst onto the global scene from Wuhan City, China in December 2019 (World Health Organization (WHO), 2020). The WHO declared it a global pandemic on March 11, 2020, and it retains the inauspicious designation today. The virus that causes COVID-19 is SARS-CoV-2 (Severe Acute Respiratory Syndrome-Coronavirus-2) (WHO, 2020). SARS-CoV-2 has infected at least 281 million individuals around the world, causing over 5 million confirmed COVID-19 deaths (WHO, 2021). The United States has experienced over 53 million confirmed cases of COVID-19 and 818,444 confirmed deaths from it (CDC, 2021a).

Narrative self- and sense-making

Individuals commonly express their perceptions in the universal communication form of narratives (Lee et al., 2020). Since such expressions comprise much of this study's dataset, a description of narrative sense-making and the "narrative creation of self" (Bruner, 2004) is warranted. Among the things distinguishing the self: "it is sensitive to where and with whom it finds itself in the world. . . It seeks and guards coherence, eschewing dissonance and contradiction through highly developed psychic procedures" (Bruner, 2004: 6–7). This nature of the self compels researchers to consider how participants' narratives may be serving to protect their cognitions from dissonance, particularly on a topic so fiercely politicized as COVID-19. The polarized atmosphere in which COVID-19 information is spread (Hart et al., 2020) is implicated in the narratives individuals select and disseminate, as narrative is a lens used to draw meaning from experience—and especially to align that meaning with cultural expectations (Wang et al., 2017). Narrative sense-making is thereby linked to both confirmation bias and information avoidance (Chater and Loewenstein, 2016)—individuals seek out those narratives that confirm and conform to their worldviews.

Narratives are potent persuasive tools. Caulfield et al. (2019) note narratives' power to enhance recall, heighten emotional responses, and amplify sense of group belonging in the context of health misinformation. In this context, narratives have potential to influence what is perceived as memorable and credible—completely apart from what is true. Anecdotes are formidable: research indicates that individuals perceive “a person like you” to have equal credibility to a subject expert (Caulfield et al., 2019). In the midst of a pandemic, voices that are similar to one's own may be amplified by the power of narrative while medical and technical experts, speaking the language of facts and statistics, may be comparatively muted.

Narratives leveraged to advance credible scientific information may help address this problem. Saffran et al. (2020) demonstrated that, even on politicized topics, narrative communication enhanced scientists' perceived credibility. Liu et al. (2020) found that narrative-induced sadness positively correlated with both information seeking and protective behaviors during an Ebola epidemic. Lazić and Žeželj (2021) tentatively suggest the potential of narrative communication to boost vaccination rates among the hesitant.

Public understanding of COVID-19 science

The public's wide range of science comprehension has been thrown into relief by the pandemic (Bridgman et al., 2020), but has been a concern of science communicators for decades preceding the current crisis. On many issues of scientific import—COVID-19 among them (Hart et al., 2020)—politicization plays a seemingly outsize role in public perceptions. Gauchat (2012) examined the trend of public trust in science in the United States for over three decades (1974–2010), finding that trust was generally stable—except among those identifying as conservative. In 1974, conservatives' trust in science was at a zenith, surpassing that of moderates and liberals; it has since declined to the lowest of the three groups. The public's split on scientific authority and trustworthiness is a relevant piece of the science polarization problem (Rekker, 2021). Perhaps, given this backdrop, it is little wonder the emphatically scientific concept of COVID-19 was swept immediately into the political realm in the United States; other countries appear to have experienced fewer partisan squabbles around COVID-19 (Mordecai and Connaughton, 2020). This crisis may have been particularly politicized in the United States because the White House administration of the time downplayed the pandemic's severity (Moon et al., 2021). Prior research investigating disease framing by laypeople—in the context of the 2009 H1N1 outbreak in Switzerland—has suggested members of the general public may gravitate toward narratives of heroes (such as health workers and researchers), villains (including media entities and pharmaceutical companies), and victims (in that case—and this one—poorer nations) (Wagner-Egger et al., 2011).

An initial step toward understanding the perceptual context surrounding COVID-19 is capturing what individuals know and believe about it. To address misperceptions, behind-the-times perceptions, and missed perceptions, there is an urgent need to establish the backdrop of what narratives are active in the public perceptual sphere. MacDonald and Holden (2018) investigated this sphere in the Zika virus context, observing that the public frequently consults social media platforms in search of information—though the accuracy of information presented on such platforms varies considerably. This is certainly true of COVID-19; the saturated social media environment surrounding the virus has been dubbed an “infodemic” (Cinelli et al., 2020). Communicators need knowledge of which false narratives persist in the public perceptual sphere if they are to craft effective science-based narratives targeted to misunderstandings.

Almost 75% of participants surveyed in April 2020 reported exposure to contradictory COVID-19 information (Nagler et al., 2020). This suggests an undercurrent of distrust and uncertainty should be considered probable in diverse subsets of the US population.

Research questions

RQ1. What are the most prevalent understandings and misunderstandings of COVID-19 among our sample populations?

RQ2. How complete is the conceptual understanding of COVID-19 among our sample populations?

3. Method

Participants and procedure

Nine participants from each of three municipalities (Lubbock, Texas; New Brunswick, New Jersey; and San Francisco, California) were enrolled in this study, each receiving a \$15 Amazon gift card. The locations were selected for their political and geographic diversity.

Potential participants from each locale completed a screening survey—measuring science curiosity (Kahan et al., 2017), age, race/ethnicity, sex, political ideology, religiosity, and highest level of completed education—before being purposively enrolled from this pool for the study's interview portion (the selection procedure and instructions for interviewers are detailed in supplemental material).

The final pool was 37% male and 63% female (56% male and 44% female in Lubbock, 11% male and 89% female in New Brunswick, and 44% male and 56% female in San Francisco). The New Brunswick sample contained a marked gender disparity—of the 39 screening survey responses, three were male: one failed to provide contact information; the other two were contacted for interviews, but only one participated. Participants identified their races as white (48% of the sample), Black/African American (33% of the sample), Hispanic/Latino (15% of the sample), and Asian (11% of the sample)—percentages exceed 100 because several participants identified as two races/ethnicities. The sample was 59% Democrat, 33% Republican, 4% third party, and 4% no answer. Religiosity in each region ranged from low to high, as did science curiosity (save no San Francisco participants rated their science curiosity as medium-high, no New Brunswick participants rated their religiosity as low or their science curiosity as low-medium, and no Lubbock participants rated their religiosity as high) (see Table 1).

Each participant was assigned a pseudonym in alphabetical order (e.g. the first participant from Lubbock received a gender- and culturally-consistent—based upon the cultural origin of his or her actual name—pseudonym beginning with A, the second received a pseudonym beginning with B, etc.); this process was followed for each location.

Semi-structured interview procedure. Each of the 27 participants was interviewed via the Zoom video-conferencing platform between May 26, 2021 and June 28, 2021. Interviews lasted approximately 19 minutes ($SD = 11.58$), ranging from seven to 46 minutes. Each semi-structured interview consisted of five standardized questions and a varying number of unscripted follow-up questions to build upon responses to the first two. The five initial questions were: (1) “What do you know about COVID-19?”; (2) “What have you heard about COVID-19 that you think may be true?”; (3) “What would you most like to know about the disease COVID-19?”; (4) “What would you most like to know about viruses in general?”; and (5) “What would you most like to know about bacteria in general?”

Analysis

RQ1: Most common perceptions and misperceptions. Interviews were transcribed and coded along thematic lines, using an inductive coding scheme (Miles et al., 2019). Transcription was completed

Table 1. Study participants' demographics. The demographic details—including age, sex, race/ethnicity, political ideology, highest level of completed education, religiosity, and science curiosity scores—for each participant.

Pseudonym	Location	Age	Sex	Race/ethnicity	Education	Political ideology	Religiosity	Science curiosity
Abraham	Lubbock	25	Male	Black	Bachelor's	Democrat	Low	High
Betsy	Lubbock	67	Female	White, Hispanic	High school	Republican	Low-med	Low
Carl	Lubbock	24	Male	Black	Some college	Republican	Low-med	Low-med
Deliyah	Lubbock	28	Female	Black	Bachelor's	Republican	Low	Med-high
Evan	Lubbock	28	Male	Black	High school	Democrat	Low	Med-high
Fred	Lubbock	24	Male	Black	Bachelor's	Democrat	Low-med	Med-high
Garai	Lubbock	27	Male	Black	Associate's	Republican	Low	High
Heidi	Lubbock	53	Female	White	Master's	Democrat	N/A	Low
Isabella	Lubbock	37	Female	White	Master's	Republican	Med-high	Low
Alice	New Brunswick	48	Female	White	Bachelor's	Republican	Med-high	Low
Bob	New Brunswick	66	Male	White	Doctorate	Democrat	Med-high	High
Candice	New Brunswick	25	Female	White	Some college	Democrat	Low-med	Med-high
Danielle	New Brunswick	32	Female	Hispanic	Bachelor's	No answer	Med-high	Low
Esther	New Brunswick	34	Female	Hispanic	Master's	Democrat	Low-med	High
Flo	New Brunswick	48	Female	Black	Bachelor's	Democrat	High	Low
Giselle	New Brunswick	31	Female	Black	Master's	Democrat	High	Low
Helen	New Brunswick	55	Female	White	Master's	Republican	High	Low
Iris	New Brunswick	77	Female	White	Some College	Republican	Med-high	Low
Allen	San Francisco	78	Male	White	Master's	Republican	Med-high	High
Baladhi	San Francisco	35	Male	Asian	Doctorate	Democrat	Low	High
Christine	San Francisco	56	Female	White	Bachelor's	Third party	Low	Low-med
Denise	San Francisco	51	Female	Black	Bachelor's	Democrat	High	Low-med
Emily	San Francisco	43	Female	Hispanic	Some college	Democrat	Med-high	Low-med
Francine	San Francisco	65	Female	White	Bachelor's	Democrat	High	Low
Greg	San Francisco	26	Male	Asian	Master's	Democrat	Low	Low-med
Haalim	San Francisco	19	Male	White	Some college	Democrat	Med-high	High
Irene	San Francisco	40	Female	White, Asian	Bachelor's	Democrat	Low-med	High

by the Rev.com transcription service and coded by the first author using the NVivo software platform. The coding scheme was inductive: each piece of information was either given a novel descriptive code or assigned one from earlier in the coding that fit without distorting meaning.

This process resulted in a codebook containing 126 items (please consult supplemental material), four of which had 85 or more instances across the participant transcripts (none of the remainder exceeded 53 instances); these four constituted key themes: participants' personal experiences and perceptions of precautionary measures, uncertainty, and the science communication environment.

RQ2: Conceptual understandings of COVID-19. Two participants' perceptions were developed into concept maps by summarizing their answers to the first core question ("What do you know about COVID-19?") and its follow-up questions. The answer to the core question formed the first level of the map; follow-up questions elicited additional levels. By employing both conceptual mapping and inductive coding for the content analysis, this study strived to incorporate methodological coherence (Morse et al., 2002).

4. Results

Overview

Rudimentary COVID-19 knowledge was common among our participants: 23 referred to COVID-19 as a viral disease (three mentioned coronavirus and another three mentioned SARS-CoV-2), 16 cited the variability of its symptoms, 15 mentioned it is a respiratory illness, 14 that it is contagious/spreads easily, and 12 that it spreads via vapor. Many had much more complete conceptual understandings, but others did not demonstrate knowledge beyond these basic concepts.

At-risk populations were mentioned by 14 participants, and 23 conveyed uncertainty—usually about COVID-19 or precautionary measures to prevent contracting it. On precautionary measures, 22 participants mentioned vaccinations and 15 discussed masks.

Top themes

Our first research question asked what the most prevalent understandings and misunderstandings of COVID-19 were among our sample populations. We found the most prevalent themes emerging from the data were personal experience and attitudes toward precautionary measures, uncertainty, and the science communication environment. Each of these themes is explored below. Misperceptions, while not among the top themes, were also relevant to this question, and primarily concerned COVID-19 vaccinations (explored further below).

Personal experience. The most dominant theme—by a substantial margin—was personal experience, often conveyed via narratives. Most participants (78%) collectively shared personal experiences 284 times. Each personal experience was coded beginning at the start of a discrete narrative and concluding with its end. In the case of non-narrative personal experiences (e.g. factual details such as mentioning having been vaccinated or philosophical musings like "I think. . ."), coding began with the indication of personal opinion/thought/fact and ended with the resumption of non-personal details (a question from the interviewer or the participant's return to describing COVID-19 in a context other than their own or an acquaintance's, for example).

Among the most poignant narratives were those shared by Emily (San Francisco) whose close friend was hospitalized with COVID-19, and Francine (San Francisco), who had married a man

who'd had polio. "I can't help but compare it to polio," she said, "because I grew up with that scare and even though there were problems with polio [vaccines], people very much believed in getting vaccinations to eradicate it." The unwillingness of some individuals to receive vaccines today struck her as a marked contrast. "I believe in vaccines because I've seen how it can eradicate things. I think that younger people who didn't grow up around polio and that kind of thing—they don't appreciate that."

Emily expressed a concern that many people did not take COVID-19 seriously enough:

My best friend got COVID-19 and she was hospitalized, and she did come home, but her oxygen levels will drop suddenly, still. And. . . we're almost six months out. . . When she left the hospital, they played music for her because she said that the hospital she was at, so many people had not made it. . . We took it seriously the whole time. But for some people, it just seems like this thing that's out there that will never happen to them. So, they're not worried about it.

These women's narratives reinforce their perception that COVID-19 is a serious concern. Some narratives go back decades, suggesting that individuals may not only seek out but also revisit narratives that confirm their worldviews, heighten their emotional responses, and reinforce their sense of group membership (Caulfield et al., 2019; Chater and Loewenstein, 2016).

As Emily intimated, COVID-19 does not seem the same to others as it does to her: Alice (New Brunswick) situated COVID-19 within her narrative of having the flu—directly linking that narrative to her beliefs, which contrast with Emily's: "I equate COVID-19 to be similar to the flu. . . you might be down for two days, or maximum one time I was down for four days . . . I've always thought of COVID as just a really hardcore flu."

Perceptions of precautionary measures

Of the precautions mentioned (vaccinations, hand-washing, social distancing, and wearing masks), none came up as frequently as vaccinations. The COVID-19 vaccines were mentioned 88 times and by 81% of the participants. This is hardly surprising, given the unprecedented feat of developing three federally approved vaccines in under a year, and the media saturation of this achievement.

At the time of this study, media coverage of vaccinations was prodigious: The Associated Press (AP) (2021a) published 79 stories featuring COVID-19 vaccinations during the 34-day period in which our interviews took place. During the same time frame, only three AP (2021b) articles on COVID-19 mentioned masks in their title or lede. It is possible the greater news coverage of vaccinations contributed to their ubiquitous mentions among our participants. Opinions on inoculations were not uniform: vaccinations were the primary topic of misperceptions and one of the top magnets for distrust in our samples (see "distrust" and "misperceptions" below).

Many participants readily shared that they'd been vaccinated, and Iris (New Brunswick) described the lengths she had gone to: "my husband and I, we are both older people, 75 and 76, and had the devil of a time getting vaccinated. We put ourselves down for every place that you could possibly sign up for. We had to travel, each of us to a different place."

All the precautionary measures referenced—except for hand-washing, which was only ever perceived with positivity or equivocation—conveyed the gamut of attitudes from positive to negative. "There's, from my understanding, contradictory evidence as to how effective masks really are," Giselle (New Brunswick) said. Helen (New Brunswick) reported wearing masks when required to but demonstrated disapproval for wearing them alone outside: "There's no one around

them, and they just walk around with a mask. . . It's not rational." Emily reported her social circle (herself included) wore masks even outside: "if everyone wears a face mask, then we're all protected. And if some people don't, then we're not as protected."

Alice reported: "they say social distancing is important. I don't know if that's a truth or a precaution." Flo (New Brunswick) was more adamant in her belief that this precaution is unwarranted:

One thing I know for sure that I don't believe is when they talk about walking in supermarket aisles and somebody sneezes and it goes all the way over the top of, like, the eight-foot-high shelves and goes to the other side; that I don't believe.

Varying perceptions in this area may be informed by what conforms to preexisting beliefs and group memberships; the crowded infodemic milieu makes it easy to pursue only narratives that suit one's worldview. This is explored further in "science communication during an infodemic," below. Some participants (e.g. Giselle) cited the conflicting nature of information as a reason to doubt prevailing scientific views; this phenomenon was even more evident with the theme of uncertainty.

Uncertainty. Uncertainty made up a broad coding category, being expressed by both the most- and least-informed participants. Despite the seemingly interminable pandemic, SARS-CoV-2 remains a *novel* coronavirus that is a topic of continuing study. Uncertainty was frequently paired with the "origins" code—fittingly, given the enduring uncertainty around SARS-CoV-2's origins (Bloom et al., 2021).

Some participants, including Alice and Flo, expressed uncertainty about the utility of social distancing to reduce the spread of COVID-19, even though this has been supported by public health authorities since the pandemic's early days (Kwon et al., 2021). There was also puzzlement about the wide variety of symptoms—from asymptomatic to fatal illness—attributed to COVID-19. "I'm just confused as to how the same virus could affect so many people in so many different ways," said Helen. She suspected that COVID-19 death rates were inflated—that underlying conditions were to blame for at least some of the deaths attributed to the virus. Uncertainty may be serving as a tool to support narratives and cognitions that are supporting group identities. This has been observed on a larger scale, with other politicized scientific topics such as anthropogenic climate change: individuals cite uncertainty as a reason to distrust science that they perceive threatens their group identities (Oreskes and Conway, 2011).

Some of the most informed participants described uncertainties that lie at the cutting edge of evolving virology—such as the questions of whether COVID-19 is more or less resistant to sunlight than other viruses (Allen (San Francisco)), how strongly linked it may be to neurological disorders (Baladhi), and what some of its yet-to-be-seen long-term effects might be (San Francisco's Baladhi, Denise, Francine, Haalim, and Irene). Uncertainty is inherent to science. A greater tolerance for uncertainty might insulate individuals from the distrust that is prone to arise when health authorities are perceived to be "changing their minds" (a concern voiced by Lubbock's Betsy)—when really science is uncovering new details that upend previous hypotheses (see "distrust" below). This is consistent with Farias and Pilati's (2021) finding that aspects of conspiratorial thinking are predicted by uncertainty intolerance.

Science communication during an infodemic. A total of 56% of our participants mentioned science communication, with 85 mentions overall. There were both positive and negative perceptions of the media's role during the pandemic, with many participants expressing ambivalence. Heidi (Lubbock) perceived the (broadly defined) media to be a mixed bag:

There's definitely so much information, so much misinformation, and you definitely got to blame the media for that. Obviously media has its good and bad . . . when I say media, I don't mean journalists. I mean the whole entire encompassing of anything that anyone might've heard from somewhere else that maybe they spread or forward or share.

Christine (San Francisco) was of the opinion that the problem was, rather, a *dearth* of information: "the lack of information, I think, tends to lead to misinformation." She suggested that media outlets traditionally affiliated with the two US political sides—Fox News and CNN—were both to blame for not robustly sharing everything that was known. She expressed concern that CNN was so caught up in the "it's safe and effective messaging" that they "glossed over" the differences between emergency use authorization and traditional Food and Drug Administration approval.

Many participants did not differentiate between credible and non-credible media, discussing all COVID-19 (mis)information as the monolithic "media." This raises concerns when an individual encounters a false story and subsequently doubts the credibility of all stories, as may be the case with Helen:

I can't remember the specific story, but someone was claiming that a little baby died from [COVID-19] and this was sometime last year . . . And then it turned out the baby had another sickness and I don't know why people were saying it was COVID; that was a lie. So it was something going on with the media.

Several participants cited science coverage they considered particularly good. Denise described science writers for *The New York Times*' science newsletter and *The Atlantic Monthly* as "journalists that cover science and know how to cover it well." Francine noted her admiration for BBC (in contrast to American news outlets, which she described as "too hysterical").

Some participants provided direct recommendations for science communicators. Esther (New Brunswick) was curious about whether immediately showering upon returning home after being out during the pandemic was unnecessary; she suspected it was but hadn't been explicitly told so—and wishes she had been. Christine suggested, "some simple media explainers" about mRNA technology and the COVID-19 vaccinations "would go a long way."

Irene (San Francisco), who is a science communicator, concurred that basic explainers could be effective. She suggested that a lack of basic understandings is part of what is contributing to misinformation about mRNA technology in the Pfizer-BioNTech and Moderna vaccines: people are "hearing these stories, like, 'what's mRNA to begin with?' A lot of people are like, 'well, it must be like DNA.' That's one of the biggest misinformation stories—that it's like gene therapy and it will change your DNA."

Irene reported she never dismisses individuals' questions, like how safe and effective COVID-19 vaccinations will be long-term:

We'll say, 'well, it hasn't been necessarily studied with this vaccine in particular, but what we do know is that vaccines in general do not cause long-term effects.' It's just trying to give them reassurance that there actually is a large body of knowledge that we're working on here—not just what we've learned in the last year-and-a-half, but years and years of research and science around vaccines and viruses and therapeutics.

Denise suggested that the role of uncertainty in scientific practice needs to be communicated, "because people need to begin to understand science is. . . based on the data that you have at hand and the data can always change." Weisberg et al. (2020) found that understanding the nature of the scientific enterprise correlates with acceptance of scientific findings, lending credence to Denise's perception.

Other themes

The following themes were not abundant but do represent salient areas for study in the context of public understanding of science.

Distrust

Distrust was almost always directed toward elite institutions: the Centers for Disease Control and Prevention (CDC), Dr Fauci (the director of the National Institute of Allergy and Infectious Diseases within the National Institutes of Health) the news media, pharmaceutical companies, and China.

Betsy took issue with Dr Fauci's inconsistency. This may not be unwarranted—major health authorities in the United States (Dr Fauci among them) first advised against mask-wearing in February and March of 2020, and then changed this recommendation in April of 2020 (Fazio, 2021). Helen reported,

Dr. Fauci says one thing and the CDC says something else, and then they change their mind. I think not too long ago, didn't the CDC come out with that we didn't have to wear masks if we are vaccinated and we're around other people that are vaccinated? And Dr. Fauci said you should still wear masks. And then Dr. Fauci said we're still contagious. And then the CDC said that even if we have it in us, it's not strong enough to spread to others.

She also expressed suspicion that the virus could have been released intentionally. "I honestly believe with all the attacks we've had, it wouldn't surprise me if someone did this. I mean, look how they've crippled the USA"

Some participants felt—or knew others who felt—that the vaccines were not to be trusted, because of the rapidity of their development. Heidi believed this—but still received a vaccination: "The vaccine obviously was rushed through, which was a little worrisome," she said, "but my chances, I decided, were worth taking it to see rather than waiting. . . I'm upset in the first place all this happened, because it shouldn't have even got out of China." Her distrust of the vaccine paled in comparison with her distrust of China:

I've spoken with someone who works in a lab, and she was pretty sure that even the scientists that came up with [COVID-19] there trained here [in the USA] and we basically have taught them what to do and how to do things like this, and supposedly it was going to be tested on a little village in China and it got out.

There is no substantiated evidence in favor of SARS-CoV-2 being a bioweapon, though it is true that the origin of the virus—zoonotic or lab-escaped—remains unknown (Bloom et al., 2021).

Misperceptions. While there were few conspiracy theories shared by our sample, some participants were eager to share those theories they'd heard from friends and family members, all of which concerned COVID-19 vaccines. Francine said her daughter

believes that aliens basically are controlling [COVID-19 vaccinations], like *The Matrix*. She believes that aliens would want people to get vaccinations, because the vaccination's got something to do with calcifying the pineal gland, and if you stop taking vaccinations then you can see the aliens who are among us.

Other misperceptions witnessed by our participants include those Irene, as a science communicator, is working to dispel—that the vaccines are "gene therapy [that] will change your DNA," that

“they made me magnetic,” and that they are used to microchip recipients. The latter was also mentioned by Emily:

They’ve heard other people, usually on social media that they believe or trust, talk about how Bill Gates and the Foundation has said that they’re going to microchip people with the vaccine. When in fact, I’ve heard from other more credible sources, that I trust, that it’s out of context; they’ve talked about how, ‘maybe we can microchip our vaccine records inside of us.’

The provenance of the microchipping theory may be a technology in development that would insert immunization records in one’s skin to indicate which children had received vaccines in countries with unavailable or inconsistent paper records (Weintraub, 2018). That work was indeed funded by the Bill & Melinda Gates Foundation as a part of its effort to eradicate devastating diseases around the world via vaccination (Weintraub, 2018).

Helen shared that acquaintances of hers say, “they are injecting us with poison. They’re saying that the vaccine kills our immune system so we can’t fight anything.” This particular concern may be related to fears about antibody-dependent enhancement (ADE)—a phenomenon whereby previous infection with (or vaccination against) an illness has spurred the immune system to produce antibodies that are not effective against the infection upon a second encounter with the pathogen (Lowe, 2021). Lowe (2021) provides a succinct rebuttal to this fear.

Irene shared that her acquaintances were afraid that “VAERS [Vaccine Adverse Event Reporting System] is showing all these deaths due to the vaccine. And I have to explain to them, ‘this is not a verified source of information. Anybody can publish what they want into it’”—true, for the record (VAERS, 2021)—“and we can’t determine whether these deaths were caused by the vaccine or not.” Bob, from New Brunswick, shared that he knew a woman who was concerned about the vaccine’s supposed effect on her “reproductive health.” Denise was similarly bewildered by claims that the vaccine is costing women their fertility.

They’re like, ‘I can’t trust science,’ and I’m like, ‘you can’t trust science because you’re looking for certainty and science is never about certainty.’ It’s just about, this is how much we know, and—based on this knowledge—this is what we recommend. That’s it. And that you’re making up [redacted] that you’re going to become infertile. . . . you people have lost your everlasting minds!

Male (2021) explores the source of this concern, offering a measured explanation of its falsity and reasons for confidence in COVID-19 vaccination, regardless of childbearing intentions. Commonly, those participants who mentioned acquaintances’ misperceptions shared frustration like Denise’s that such misperceptions persist.

Some participants were invested in more commonplace misperceptions about the vaccine: that it was unsafe—or at least suspect—for having been developed so quickly (a view held by Heidi and Helen) and that it has had no effect on slowing the viral spread (suggested by Lubbock’s Fred and Garai).

Less commonly, individuals expressed misperceptions about viruses and bacteria, such as that bacteria “are the living part, and then the virus has just come from it” (Betsy), that mold and fungus are types of bacteria (Alice), and that COVID-19 is a bacterial infection (Giselle). Viruses and bacteria are separate microbes—viruses are not elements of bacteria. Neither molds nor the broader category of fungus are bacteria—and neither is the COVID-19 virus.

Flo suggested that at least some instances of reported loss of taste and/or smell from COVID-19 were imagined and that, “I don’t know if I truly believe that a hug will transmit the virus. . . . For me, if you keep your mouth shut as you hug the person, maybe it will be okay.” In reality, the

COVID-19 virus can be transmitted via any respiration—whether from the mouth or the nose (Bleier et al., 2020).

Giselle said, “I’ve heard that kids can’t get [COVID-19].. . I don’t know any children that have gotten it, so maybe there’s some level of truth to that.” While children can contract COVID-19, most are asymptomatic or only mildly symptomatic (Bhopal et al., 2021; CDC, 2020). She likewise believed it is easy to contract COVID-19 from surfaces. Research indicates that the risk of contracting COVID-19 from an inanimate object is actually less than one in 10,000 (Anthes, 2021). Emily inflated the risk of contracting COVID-19 while outdoors and unmasked. The risk of contracting COVID-19 while outside without a mask is conservatively estimated as being under 1%—and may even be under 0.1% (Leonhardt, 2021).

Conceptual understandings of COVID-19

Our second research question asked how complete participants’ conceptual understandings of COVID-19 were. We found there was substantial variability in the extent of conceptual understandings. The following participants were selected to illustrate one extensive understanding and one much sparser understanding.

Bob (New Brunswick). Bob’s is a thorough conceptual understanding of COVID-19 (Figure 1). Bob holds a Ph.D. and is a toxicologist. He knew that COVID-19 is one of many coronaviruses, that its discovery in 2019 was the reason for its name, and that coronaviruses are distinguished by a crown of spike proteins (a “proteinaceous configuration”) that makes it successful at attacking soft lung tissues. He knew COVID-19 is a respiratory virus, taking advantage of the respiratory system as one of three major routes by which pathogens infect humans. This also accounts for its distribution being primarily airborne. Bob found it fascinating that COVID-19’s observed severity is concentrated among the elderly—but not the youngest—whereas many viruses most severely affect both (the young because their immune systems are underdeveloped and the elderly because theirs are compromised). Because of this unusual distribution, COVID-19 hit Italy particularly hard, where there is an unusually elderly population. Those with more comorbidities were also more severely affected by COVID-19.

Bob reported that social distancing and masks work—they account for the slowed rate of hospital admissions at the times of these measures’ widespread implementation. Bob said only 10% of those hospitalized with COVID-19 who are put on ventilators survive—this was true in the early days of the pandemic but has since improved to around 37% (Bernstein, 2020). Bob stated that a high percentage of cases are asymptomatic, that the virus may have originated in Wuhan, and that the three major vaccines available in the United States are effective. The Pfizer vaccine he put at 95% effectiveness (100% for children 12–18 years of age) (confirmed by Mayo Clinic, 2021). He put the Moderna vaccine at 96% efficacy—the CDC (2021b) puts it at 94.1%. The Johnson & Johnson vaccine, he reported, is 64% effective; the CDC (2021c) puts it at 66.3%—but Bob added that this may not be fair to this vaccine, which came out when there were more COVID-19 variants to contend with.

Fred (Lubbock). Fred had a more constricted conceptualization of COVID-19 (Figure 2), reporting only basic facts. These included: it’s an infectious disease that spreads fast, went through many countries (making it a pandemic), claimed many lives (because of its infectiousness and that it affects the breathing system), caused economic disruption (by hurting production) and is accompanied by the symptoms of fever, shortness of breath, coughing, and sneezing—the latter, however, is not a symptom of COVID-19, according to the CDC (2021d).

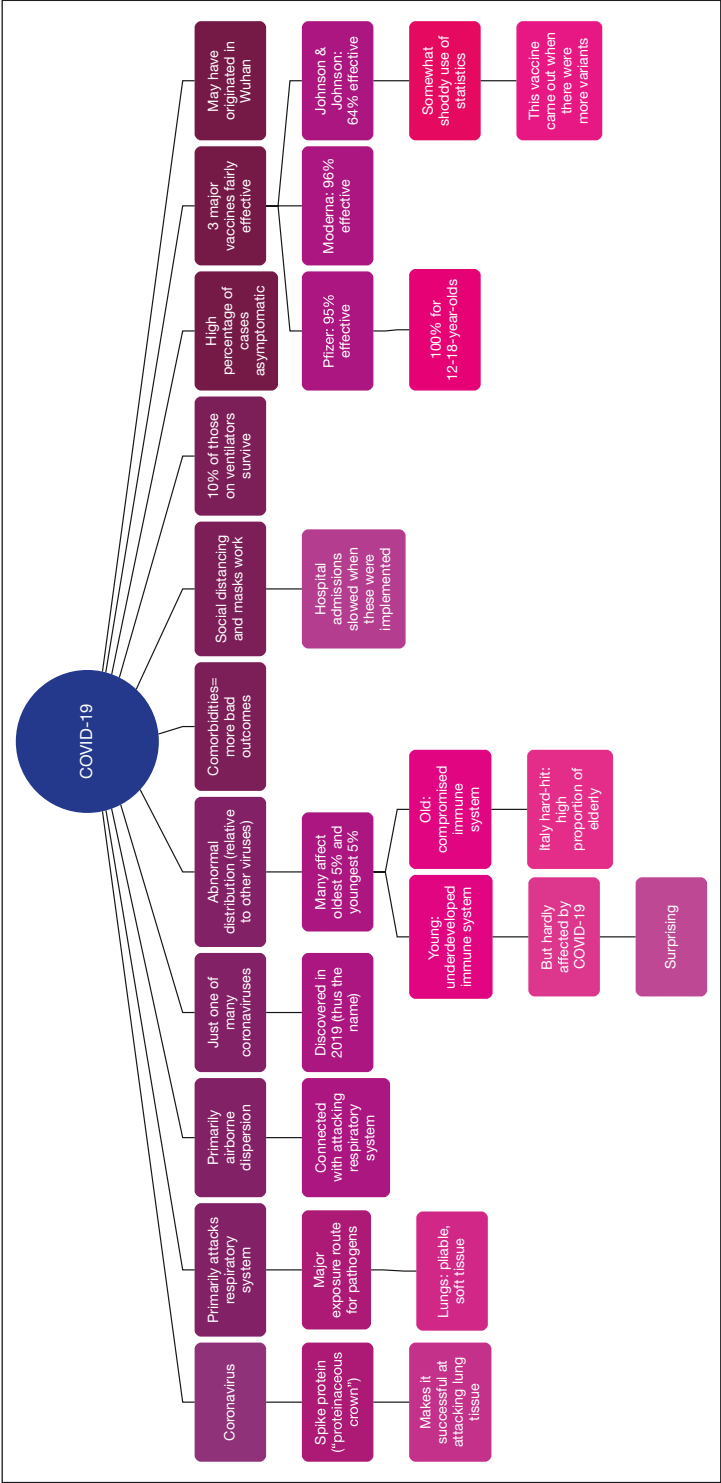


Figure 1. Bob's concept map. Participant Bob's conceptual understanding of COVID-19, as depicted via concept map.

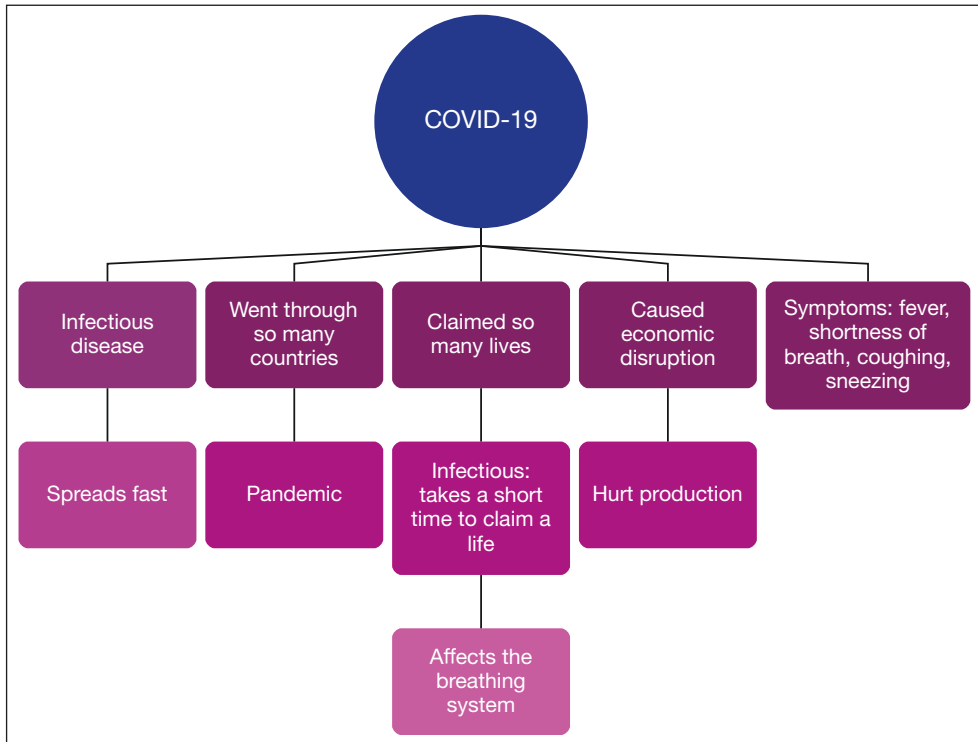


Figure 2. Fred's concept map. Participant Fred's conceptual understanding of COVID-19, as depicted via concept map.

5. Discussion

The goal of this research is to present a snapshot of the experiences and cognitions shaping individuals' perceptions of COVID-19. Knowledge of such snapshots is intrinsically valuable: aside from historical preservation of cognitions and perceptions at this moment, communicators today can glean insight into what has been poorly communicated, miscommunicated, or remains to be communicated to the public by perusing these vignettes.

Most of the snapshots are stories, highlighting the relevance of narrative sense-making theory. It is perhaps little wonder citing medical experts was less frequent than sharing personal experiences, as experts tend to address the public using facts and statistics—only rarely (if ever) employing the narrative form that is ubiquitous among one's friends and family members. This may also explain why “distrust” was a category in which medical/public health experts received mentions. Caulfield et al. (2019) support the notion that similar-to-oneseif individuals are perceived as equal in credibility to experts, and that narrative communication facilitates this perception. Another possible explanation for the “distrust” elements that arose among our samples is the public's widespread perception that COVID-19 information is conflicting (Nagler et al., 2020); Betsy mentioned conflicting information to explain her distrust of media.

Several themes consistently predominated: perceptions of precautions, uncertainty, and science communication. Each has enormous relevance to public health and medical science communicators; they represent the top-of-mind (mis)perceptions that arise in an interview setting. The latter two are especially telling; that there are still uncertainties—not only in areas where science is still

seeking answers, but also in those where it has long-ago rendered confident ones—over 1 year into the pandemic points to areas that communicators may focus on while this pandemic persists and keep in mind when the next one arrives.

Our first research question sought to explore the most common (mis)perceptions about COVID-19 in our samples. We found the key themes highlighted the most common understandings and misunderstandings: no topic prompted more misperceptions than vaccinations, which—along with science communication—were the topics most prone to eliciting distrust. Misperceptions about vaccinations included concerns about the speed of their development and the perception that they are ineffective. Participants also shared that their acquaintances had additional concerns: that the vaccinations hurt fertility, damage the immune response to future threats, or cause mortality. Such misperceptions suggest a continued emphasis of the safety and efficacy of COVID-19 vaccinations is warranted.

The second research question asked how complete the understanding of COVID-19 was among our samples. We found conceptual understandings varied considerably between participants. This suggests that science communicators may, depending upon their communication outlet, have diverse audiences with diverse levels of understanding of COVID-19, even over 1 year into the pandemic. Content that is intimately familiar to some audience members may be completely novel to others.

Narratives are both powerful persuasive tools (Caulfield et al., 2019) and agents of confirmation bias and information avoidance (Chater and Loewenstein, 2016); individuals are likely to both seek out and cling to those narratives that reinforce their existing worldviews. Saffran et al. (2020) indicate that narrative science communication enhances perceived authenticity. While communicators may endeavor to use narratives to improve the perceived trustworthiness of credible scientists, the narrative effect may also be bolstering non-credible sources: Heidi's belief that COVID-19 is the result of an escaped biological weapon seems to have stemmed from a laboratory worker's narrative. Caulfield et al. (2019) observe that, "addressing the spread of misinformation through persuasive narratives seems essential, though it will not be easy" (p. 55).

Since narratives also enhance recollection, emotional investment, and group identity (Caulfield et al., 2019), those containing misinformation are likely to continue circulating in groups that derive identity-protecting meaning from them—and to be resistant to correction via facts and reasoning. Giselle drew on her personal experience of not knowing any children who contracted COVID-19 as a confirmation that maybe children can't. Even participants who did not believe false narratives were eager to share the ones they'd heard, which are some of the most memorable utterances we recorded. Francine's daughter's alien invasion story is justifiably captivating. But so is Francine's story of the relief brought about by polio vaccines. Stories like hers may be leveraged to speak to facts that—in non-narrative forms—have gained little traction.

Limitations

The perceptions and conceptual understandings of our participants do not necessarily reflect the understandings of the United States as a diverse whole, though they do illuminate a subset of the perceptions and misperceptions about COVID-19. Several interviews were shorter than anticipated; the diversity of perspectives we aimed to recruit increased the likelihood of including participants who had either very little to say about COVID-19 or very little trust in researchers, academia, or the institutions that support them (and therefore little desire to share information with interviewers). There may have been participants who could be persuaded to speak for longer with the right rapport, and while effort was made to establish this, it may not have universally succeeded. Similarly, there is the possibility that social desirability may have prompted participants to

present conspiracy-minded ideas as their acquaintances' views, rather than their own. However, because these ideas were frequently presented alongside participants' expressed frustration with them and the way they'd strained relationships, this seems a minor concern.

6. Conclusion

Our participants primarily communicate in stories; some of their strongest aversions and admirations are in response to stories, and it is evident that trust can be lost at the drop of a story. While our participant pool is far from large and representative enough to be generalizable, it seems evident that two key factors for effectively communicating science, at least to some, are using narratives and robust reporting—not “glossing over” the parts a communicator finds unpalatable. The message, meanwhile, ought to take the form of “simple media explainers” about those hot-topic issues: COVID-19 vaccines, the mRNA technology that made them possible, and the role of uncertainty in the practice of science. Given persisting vaccine misperceptions, it seems prudent for communicators to investigate ways to reassure the public that COVID-19 vaccines have been found to be safe and effective, have not been linked to increasing deaths—or adverse fertility effects—and are not part of a vast conspiracy (whether by extraterrestrial visitors or more mundane earthly governments).

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Supplemental material

Supplemental material for this article is available online.

References

- Anthes E (2021) Has the era of overzealous cleaning finally come to an end? This week, the CDC acknowledged what scientists have been saying for months: The risk of catching the coronavirus from surfaces is low. *The New York Times*, 8 April. Available at: <https://www.nytimes.com/2021/04/08/health/coronavirus-hygiene-cleaning-surfaces.html#:~:text=This%20week%2C%20the%20C.D.C.,>

- coronavirus%20from%20surfaces%20is%20low.&text=Sign%20up%20for%20Science%20Times,cosmos%20and%20the%20human%20body.
- Associated Press (AP) (2021a) Coronavirus vaccine. Available at: <https://apnews.com/hub/coronavirus-vaccine> (accessed 4 August 2021).
- Associated Press (AP) (2021b) Coronavirus pandemic. Available at: <https://apnews.com/hub/coronavirus-pandemic> (accessed 4 August 2021).
- Bernstein L (2020) More COVID-19 patients are surviving ventilators in the ICU. *The Washington Post*, 3 July. Available at: https://www.washingtonpost.com/health/more-covid-19-patients-are-surviving-ventilators-in-the-icu/2020/07/03/2e3c3534-bbca-11ea-8cf5-9c1b8d7f84c6_story.html
- Bhopal SS, Bagaria J, Olabi B and Bhopal R (2021) Children and young people remain at low risk of COVID-19 mortality. *The Lancet: Child and Adolescent Health* 5(5): E12–E13.
- Bleier BS, Ramanathan M and Lane AP (2020) COVID-19 vaccines may not prevent nasal SARS-CoV-2 infection and asymptomatic transmission. *Otolaryngology—Head and Neck Surgery* 164(2): 305–307.
- Bloom JD, Chan YA, Baric RS, Bjorkman PJ, Cobey S, Deverman BE, et al. (2021) Investigate the origins of COVID-19. *Science* 372(6543): 694.
- Bridgman A, Owen T, Zhilin O, Merkley E, Ruths D, Loewen PJ, et al. (2020) The causes and consequences of COVID-19 misperceptions: Understanding the role of news and social media. *Harvard Kennedy School (HKS) Misinformation Review*. Available at: <https://misinforeview.hks.harvard.edu/article/the-causes-and-consequences-of-covid-19-misperceptions-understanding-the-role-of-news-and-social-media/>
- Bruner J (2004) The narrative creation of the self. In: Angus LE and McLeod J (eds) *The Handbook of Narrative and Psychotherapy: Practice, Theory, and Research*. Thousand Oaks, CA: SAGE, pp. 1–14.
- Caulfield T, Marcon AR, Murdoch B, Brown JM, Perrault ST, Jarry J, et al. (2019) Health misinformation and the power of narrative messaging in the public sphere. *Canadian Journal of Bioethics* 2(2): 52–60.
- CDC (2020) COVID-19 in children and teens. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/children/symptoms.html> (accessed 23 July 2021).
- CDC (2021a) COVID data tracker. Available at: <https://covid.cdc.gov/covid-data-tracker/#datatracker-home> (accessed 29 December 2021).
- CDC (2021b) Moderna COVID-19 vaccine overview and safety. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/Moderna.html> (accessed 23 July 2021).
- CDC (2021c) Johnson & Johnson's Janssen COVID-19 vaccine overview and safety. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/janssen.html> (accessed 23 July 2021).
- CDC (2021d) Symptoms of COVID-19. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html> (accessed 24 July 2021).
- Chater N and Loewenstein G (2016) The under-appreciated drive for sense-making. *Journal of Economic Behavior & Organization* 126: 137–154.
- Cinelli M, Quattrocioni W, Galeazzi A, Valensise CM, Brugnoli E, Schmidt AL, et al. (2020) The COVID-19 social media infodemic. *Scientific Reports* 10: 16598.
- Farias J and Pilati R (2021) COVID-19 as an undesirable political issue: Conspiracy beliefs and intolerance of uncertainty predict adhesion to prevention measures. *Current Psychology*. Epub ahead of print 2 February. Available at: <https://pubmed.ncbi.nlm.nih.gov/33551627/> (accessed 27 December 2021).
- Fazio M (2021) How mask guidelines have evolved: Officials offered mixed messages about masks in the early days of the coronavirus pandemic before embracing them as a simple but effective tool for slowing the spread of Covid-19. *The New York Times*, 27 April. Available at: <https://www.nytimes.com/2021/04/27/science/face-mask-guidelines-timeline.html>
- Gauchat G (2012) Politicization of science in the public sphere: A study of public trust in the United States, 1974 to 2010. *American Sociological Review* 77(2): 167–187.
- Hart PS, Chinn S and Soroka S (2020) Politicization and polarization in COVID-19 news coverage. *Science Communication* 42(5): 679–697.
- Kahan DM, Landrum A, Carpenter K, Helft L and Jamieson KH (2017) Science curiosity and political information processing. *Political Psychology* 38(S1): 179–199.
- Kwon S, Joshi AD, Lo C, Drew DA, Nguyen LH, Guo CG, et al. (2021) Association of social distancing and face mask use with risk of COVID-19. *Nature Communications* 12: 1–10.

- Lazić A and Žeželj I (2021) A systematic review of narrative interventions: Lessons for countering anti-vaccination conspiracy theories and misinformation. *Public Understanding of Science* 30(6): 644–670.
- Lee H, Bellana B and Chen J (2020) What can narratives tell us about the neural bases of human memory? *Current Opinion in Behavioral Sciences* 32: 111–119.
- Leonhardt D (2021) A misleading C.D.C. number. *The New York Times*, 25 May. Available at: <https://www.nytimes.com/2021/05/11/briefing/outdoor-covid-transmission-cdc-number.html>
- Liu BF, Austin L, Lee Y, Jin Y and Kim S (2020) Telling the tale: The role of narratives in helping people respond to crises. *Journal of Applied Communication Research* 48(3): 328–349.
- Lowe D (2021) Antibody-dependent enhancement and the coronavirus vaccines. In: Science Translational Medicine, 12 February. Available at: <https://blogs.sciencemag.org/pipeline/archives/2021/02/12/antibody-dependent-enhancement-and-the-coronavirus-vaccines> (accessed 12 July 2021).
- MacDonald PDM and Holden EW (2018) Zika and public health: Understanding the epidemiology and information environment. *Pediatrics* 141: S137–S145.
- Male V (2021) Are COVID-19 vaccines safe in pregnancy? *Nature Reviews Immunology* 21: 200–201.
- Mayo Clinic (2021) COVID-19 vaccines for kids: What you need to know. Available at: <https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/covid-19-vaccines-for-kids/art-20513332> (accessed 12 July 2021).
- Miles MB, Huberman AM and Saldaña J (2019) *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oaks, CA: SAGE.
- Moon WK, Atkinson L, Kahlor LA, Yun C and Son H (2021) U.S. political partisanship and COVID-19: Risk information seeking and prevention behaviors. *Health Communication*. Epub ahead of print 27 April. DOI: 10.1080/10410236.2021.1912948.
- Mordecia M and Connaughton A (2020) Public opinion about coronavirus is more politically divided in U.S. than in other advanced economies. Available at: <https://www.pewresearch.org/fact-tank/2020/10/28/public-opinion-about-coronavirus-is-more-politically-divided-in-u-s-than-in-other-advanced-economies/> (accessed 12 July 2021).
- Morse JM, Barrett M, Mayan M, Olson K and Spiers J (2002) Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods* 1(2): 13–22.
- Motta M, Stecula D and Farhart C (2020) How right-leaning media coverage of COVID-19 facilitated the spread of misinformation in the early stages of the pandemic in the U.S. *Canadian Journal of Political Science* 53(2): 335–342.
- Nagler RH, Vogel RI, Gollust SE, Rothman AJ, Fowler EF and Yzer MC (2020) Public perceptions of conflicting information surrounding COVID-19: Results from a nationally representative survey of U.S. adults. *PLoS ONE* 15(10): e0240776.
- Oreskes N and Conway EM (2011) *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Climate Change*. New York, NY: Bloomsbury Press.
- Rekker R (2021) The nature and origins of political polarization over science. *Public Understanding of Science* 30(4): 352–368.
- Saffran L, Hu S, Hinnant A, Scherer LD and Nagel SC (2020) Constructing and influencing perceived authenticity in science communication: Experimenting with narrative. *PLoS ONE* 15(1): e0226711.
- VAERS (2021) Frequently asked questions (FAQs). Available at: <https://vaers.hhs.gov/faq.html> (accessed 10 July 2021).
- Wagner-Egger P, Bangerter A, Gilles I, Green E, Rigaud D, Krings F, et al. (2011) Lay perceptions of collectives at the outbreak of the H1N1 epidemic: Heroes, villains and victims. *Public Understanding of Science* 20(4): 461–476.
- Wang Q, Song Q and Kim Koh JB (2017) Culture, memory, and narrative self-making. *Imagination, Cognition and Personality* 37(2): 199–223.
- Weintraub K (2018) Invisible ink could reveal whether kids have been vaccinated: The technology embeds immunization records into a child's skin. *Scientific American*, 18 December. Available at: <https://www.scientificamerican.com/article/invisible-ink-could-reveal-whether-kids-have-been-vaccinated/>

- Weisberg DS, Landrum AR, Hamilton J and Weisberg M (2020) Knowledge about the nature of science increases public acceptance of science regardless of identity factors. *Public Understanding of Science* 30(2): 120–138.
- World Health Organization (WHO) (2020) Origin of SARS-CoV-2. Available at: https://apps.who.int/iris/bitstream/handle/10665/332197/WHO-2019-nCoV-FAQ-Virus_origin-2020.1-eng.pdf (accessed 6 July 2021).
- World Health Organization (WHO) (2021) Coronavirus disease (COVID-19) pandemic. Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019> (accessed 29 December 2021).

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