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# Arguing about controversial science in the news: Does epistemic uncertainty contribute to information disorder?

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Abstract. News informs the public, especially in crisis situations. The news significantly impacted the public's beliefs about COVID-19. Handling uncertainty in scientific evidence production is a particular challenge. The public controversy in the United States over mask mandates and the effectiveness of masks to prevent COVID-19 was reignited by a controversial scientific review article that Cochrane published in early 2023, which concluded "There is uncertainty about the effects of masks." The current paper presents a case study of 58 news articles that linked to the review article according to Altmetric.com; news articles were published from February 1, 2023 to March 9, 2023 (inclusive). We use an argument mapping approach called polylogue analysis to diagram the players and positions covered in the news. We find that news articles citing the Cochrane Review took contradictory positions such as "masks work" and "masks don't work," neither of which was falsified by the conclusions of the review article. However, these positions require further contextualization. We argue that current definitions of information disorder, which focus on misinformation, disinformation, and malinformation, cannot adequately account for the challenges associated with conveying scientific information. In particular, due to epistemic uncertainty, multiple contradictory positions can coexist as credible. Future work on information disorder in science needs to consider not only the intention to harm but also the risks associated with oversimplification or decontextualization of current scientific evidence.

Keywords: altmetrics  $\cdot$  argument mapping  $\cdot$  epistemic uncertainty  $\cdot$  masks for COVID-19  $\cdot$  scientific controversies

# 1 Introduction

News informs the public, especially in crisis situations. The news significantly impacted the public's beliefs about COVID-19 [11,24,43,50]. However, informing the public is more difficult with the disruption of traditional print news and a concomitant increase in online news, which have decreased the number of full-time science journalists working for major news outlets [23,56].

Handling uncertainty in scientific evidence production [23] is a particular challenge. News about scientific controversies may be reported with dramatization; a common problem is reporting a "false balance" that distorts scientific consensus instead of "making clear what the relative positions mean in relation to the current scientific understanding" [23]. Journalists' simplification of science is essential to ensure that the public can understand scientific information, but it can lead to challenges due to the contrast between the institutional logics used by the media (e.g., meeting standards of newsworthiness) and in science (e.g., embracing the complexity of scientific information) [34].

Whether mask-wearing can reduce or prevent the spread of coronavirus was the subject of continuous debate since the beginning of the COVID-19 pandemic. The public controversy in the United States over mask mandates and the effectiveness of masks for preventing COVID-19 was reignited by a controversial scientific review article that Cochrane published on January 30, 2023, called "Physical interventions to interrupt or reduce the spread of respiratory viruses" [33]. That review article includes phrases such as "little to no difference" and "uncertainty of the effects," which were often cited in US news.

Here we present a case study that analyzes altmetric news data using an argument mapping approach called polylogue analysis to explore how scientists, public health officials, and others reacted to the review article. In the rest of the paper, we first present the background and introduce our case study. We then describe our methodology and present our results. We discuss our findings, limitations, and future work before concluding the paper.

# 2 Background

Next we discuss background in five areas: how news consumption impacted Americans' understanding of COVID-19; the relationship between information disorder, trust in science, and COVID-19; epistemic uncertainty; altmetrics; and argument mapping and polylogue analysis.

# 2.1 How news consumption impacted Americans' understanding of COVID-19

News media, particularly cable news, is heavily polarized in America. Based on a nationally representative survey of the US conducted in March 2020, watching ABC News, CBS News, or NBC News correlated with "accurate beliefs" about protection from infection, while watching Fox and other conservative news correlated with the belief that the US Centers for Disease Control and Prevention (CDC) was overplaying the virus to undermine Donald Trump's presidency [24]. News sources influenced viewers' worry over perceived threat of COVID-19 and adherence to guidelines, according to Mechanical Turk surveys conducted in July and August 2020 [43]. Viewers of conservative media and Trump briefings were less likely to perceive COVID-19 as a serious threat; they doubted the efficacy of mitigation efforts and had lower intentions to adopt preventive behavior, according to a June 2020 survey [11]. Greater consumption of Fox News had a causal increase on vaccine hesitancy reflected in lower vaccination rates at the county level, even after controlling for "self-reported Republican and conservative affiliation from Gallup" based on nationwide cable news viewership statistics in April-June 2021; CNN and MSNBC viewership had no impact [50]. Households exposed to online left-wing news such as CNN, *Huffington Post*, and *The Guardian* were less likely to have a positive COVID-19 test in a nationally representative survey of the US conducted from August to November 2021 [59].

#### 2.2 Trust in science, COVID-19, and information disorder

People reason about and act on COVID-19 knowledge differently based on their trust in science [65], drawing not only on the science but also on social, economic and moral aspects [16].

A number of different factors contribute to how well informed Americans are about science [54]. Simplification of science for the news, while essential [34], is not politically neutral [26]. Journalists' own views and the interests of their audiences impact the extent to which they amplify claims about what is not known in science [61]. How news stories cover "claims intended to amplify scientific unknowns and uncertainties" impacts the public understanding of science and science-based policymaking [62]. News articles contain an amalgamation of facts and sources compiled by their authors. Articles may contain outdated facts when journalists do not use standardized verification methods [69] or lack access to people who can be relevant sources [25].

Information disorder refers to misinformation ("content that is false but not intended to harm"), disinformation ("content that is false and intended to harm"), and malinformation ("truthful information that is intended to harm")[70]. A small amount of misinformation can have an outsized effect, due to personalization of information and peoples' propensity to seek out confirmatory information [54]. A study selecting 100 news articles about vaccines for COVID-19 from June 2021 detected that only 3.2% contained misinformation, whether included as primary information, fact-checking errors or references made to other misinformation [41]. However, visitor traffic to web pages with articles containing misinformation was proportionally larger than traffic to other articles [41].

## 2.3 Epistemic uncertainty

Gaps or disconnects within and between bodies of research should be expected, yet people are averse to accepting uncertainty [8]. Crises demand urgent action from policymakers to determine the most reliable information available [15]. Pressure for scientists to "speak in one voice" to simplify scientific discussion and minimize epistemic uncertainty [29] can backfire: Overconfidence in science can undermine public trust in scientific expertise [72]. Policymakers often need to make decisions in the absence of scientific evidence, or with suboptimal evidence [4]. One common consideration is the *precautionary principle*: minimize

risks in the face of uncertainty [22]. Another consideration is that absence of evidence is not evidence of absence [4]. Accepting scientific uncertainty, recognizing the different speeds of science and politics, and separating the technical and political contributions to decision-making, could have improved early COVID-19 pandemic decision-making [15].

# 2.4 Altmetrics

Altmetrics measures the online attention to scientific research [52], extending traditional bibliometrics. Altmetrics data is available through a number of commercial and non-commercial data providers [47].

Altmetric Explorer is a user-friendly platform provided by Altmetric.com that allows users to retrieve altmetrics data. While news data from Altmetric.com is "a relatively reliable source" [18], the data has shortcomings [73]. Altmetric.com's composite metric which simply adds together the number of mentions in news articles, blogs, Wikipedia, and social media has been criticized for its uninterpretability [63, page 5].

We briefly review a few studies that incorporated altmetrics of COVID-19related publications. Fleerackers et al. [19] examined how news articles described COVID-19 preprints' publication status when mentioning or linking to preprints; they identified four types of uncertainty frames which were sometimes, but not consistently, used in news stories to discuss added uncertainty associated with sharing science before peer review and formal publication. Two studies used data from Altmetric.com to analyze public argumentation about mask science [10,21]: data for both studies consisted of a corpus of 4775 tweets from January to April 2020 from Altmetric.com that referred to 6 research publications on cloth masks. Altmetrics data has also been used to study how COVID-19 biomedical research was used by policy documents [49]. Recently a preprint by Alperin et al. [3] noted that social media was more likely to link to news articles discussing COVID-19 research ("second-order citations") than directly to the research articles.

#### 2.5 Argument mapping and polylogue analysis

People put forth arguments to communicate ideas, make decisions, and check that reasoning is sound. The multidisciplinary field that analyzes arguments is known as argumentation theory [14]. One powerful technique is argumentation analysis, which identifies and analyzes support and attack relationships between different positions.

The computer-supported collaborative work community has used software tools for argumentation to support sense-making and group deliberation in educational and organizational contexts [35]. Argument mapping can help clarify a group's understanding of a disagreement [20] and can be used to visualize web-scale debates [27]. In the past 15 years, technologists have also sought to develop an Argument Web, combining an interchange-focused ontology with a series of tools, systems and services [53]. For instance, chatbots to increase critical thinking have built on knowledge bases and dialogue engines [46] among other applications [38].

While argumentation is often simplified to two-position settings, such as the pro and con sides of a debate or the plaintiffs and defendants in courts, recently attention has been focused on complex, multi-party communication, described as a "polylogue" [39]. In an early demonstration of polylogue analysis Aakhus and Lewiński analyzed a single *New York Times* article on the fracking controversy to demonstrate the practical application of polylogue analysis [2]. Polylogue analysis mainly concerns players, positions, and places. Players are individuals or groups of individuals (e.g., government agencies, scientific research teams) who share their positions in particular venues, the places. In the fracking controversy, the players included local citizens, industry groups, and US federal regulators [39]. A *player* (local citizen) puts forth a *position* ("fracking makes our community unsafe") in a *place* (an informal public encounter in a local restaurant) [2]. In general, polylogue analysis considers the players, positions, and places where arguments occur.

# 3 Introducing our Case Study

We apply polylogue analysis to describe how news articles mentioned a controversial scientific review article about the effectiveness of mask-wearing in the first 5 weeks after its publication.

# 3.1 The Cochrane Review: A widely discussed article from highly regarded producers of medical reviews

Cochrane, as a review producer, is highly regarded and often considered the "gold standard" in medical literature reviews [36]. Their review "Physical interventions to interrupt or reduce the spread of respiratory viruses," published on January 30, 2023, focuses on masks, handwashing, and similar physical interventions [33]. It is the fifth version of the review, with previous versions published in 2007, 2010, 2011, and November 2020. A protocol for this series of reviews was published in 2006. We use the term "Cochrane Review" to refer to the 2023 version of the review [33], not the whole series.

The Cochrane Review reviewed Randomized Controlled Trials about the effectiveness of mask-wearing, and its conclusions report considerable uncertainty, especially at the start of a 2-page plain language summary shown in Figure 1. Its heading lists two "Key messages" [33]: "We are uncertain whether wearing masks or N95/P2 respirators helps to slow the spread of respiratory viruses based on the studies we assessed. Hand hygiene programmes may help to slow the spread of respiratory viruses."

The Cochrane Review as a whole delivered positions such as:

1. "The high risk of bias in the trials, variation in outcome measurement, and relatively low adherence with the interventions during the studies hampers drawing firm conclusions." [33]



Fig. 1. An excerpt from the Cochrane Review's [33] 2-page plain language summary as of September 17, 2023.

- 2. "There is uncertainty about the effects of face masks. The low to moderate certainty of evidence means our confidence in the effect estimate is limited,..." [33]
- "Compared with wearing no mask in the community studies only, wearing a mask may make little to no difference in how many people caught a flu-like illness/COVID-like illness..." [33]

#### 3.2 Discussion of the Cochrane Review

The uncertainty stated in Cochrane Review's conclusions provided strong support for people questioning the effectiveness of mask mandates. The Cochrane Review attracted substantial attention beyond traditional scientific venues. As of December 26, 2023, the Cochrane Review was mentioned in 480 news stories from 240 outlets and 74,344 from X [previously Twitter] posts from 48,196 X users according to Altmetric.com, putting it in the top 5% of all research outputs scored by Altmetric.com.<sup>1</sup>

Cochrane responded to the news in a statement published on March 10, 2023 by Karla Soares-Weiser, Editor-in-Chief of the Cochrane Library [57]: "Many commentators have claimed that a recently-updated Cochrane Review shows that 'masks don't work', which is an inaccurate and misleading interpretation."

#### 3.3 Evidentiary Standards of the Cochrane Review Series

Some aspects of the disagreement in the news concern what type of studies counts as evidence, as we will discuss in Section 5.2. For the 2023 Cochrane Review, the only acceptable evidence was Randomized Controlled Trials. Notably, in

<sup>&</sup>lt;sup>1</sup> https://cochrane.altmetric.com/details/141934282

previous editions in the series, from the 2006 protocol through the third version of the review in 2011, evidence from other study designs, such as observational studies, was also reviewed.

The inclusion criteria for this series of Cochrane Reviews had changed to limit to Randomized Controlled Trials as of the immediately previous, November 2020 publication [31]: "For this 2020 update we only considered individual-level RCTs, or cluster-RCTs, or quasi-RCTs for inclusion. In previous versions of the review we also included observational studies (cohorts, case-controls, before-after, and time series studies). However, for this update there were sufficient randomised studies to address our study aims, so we excluded observational studies (which are known to be at a higher risk of bias)."

The November 2020 publication was accompanied by an editorial [58] noting "lack of evidence of effectiveness is not evidence that the interventions are ineffective. Rather, the details of these reviews show why there may never be strong evidence regarding the effectiveness of individual behavioural measures when deployed, often in combination, in a general population living in the complex, diverse circumstances of individuals' everyday lives."

These same considerations hold for the 2023 version of the review [33], which Cochrane did not mark as having an important change compared to the November 2020 review conclusions. In fact, the key messages are identical except for their placement: at the end of the plain language summary (November 2020) versus the top (January 2023; see Figure 1).

# 4 Methodology

To analyze the news discussing the Cochrane Review, we first used Altmetric.com to retrieve news articles on the web, and selected a subset. Second, we extracted direct quotations. Third, we identified who was quoted and annotated the quotations. Finally, we analyzed the quotations. We managed the process using an Excel spreadsheet and MAXQDA version  $22.7.0^2$ ; data supporting our analysis is available in the Illinois Databank [74].

Retrieve and select the news articles To collect news articles on the web that discuss the Cochrane Review, we retrieved articles from Altmetric.com using their Altmetric Explorer on August 1, 2023. Overall, news articles we retrieved were published in January (1), February (193), March (108), April (53), May (31), June (8), and July (2). The selection criteria and process are depicted in Figure 2. We selected all articles written in English, published in the United States with publication date prior to March 10, 2023 (according to Altmetric.com "Mention Date"), when Cochrane issued a statement about the "misleading interpretation" [57].

<sup>&</sup>lt;sup>2</sup> https://www.maxqda.com/



Fig. 2. Process of retrieving and selecting news articles on the web that discuss the Cochrane Review

**Extract direct quotations relating to the Cochrane Review** For each of the 58 news articles, we manually extracted direct quotations of reported speech that met any of the following criteria:

- The quotation mentioned words like "mask," "mask mandates," or "Cochrane Review"; or
- The paragraphs surrounding the quotation discussed masks or the issues closely related to masks; or
- The quotation or the paragraphs surrounding the quotation hyperlinked to a source that largely discusses mask effectiveness or mask mandates.

We focused on reported speech, hence we omitted and did not analyze technical terminology set off with quotation marks, such as "best" and "effect size" from [42]: 'this approach assumes (a) RCTs are the "best" evidence and (b) combining results from multiple RCTs will give you an average "effect size".' Our extraction included surrounding words and sentences, and in one case, a news agency's commentary, around direct quotations for context where needed. The quotations (with context) are the positions in our analysis.

**Identify who was quoted** We identified who was quoted; these are the players in our analysis. We grouped similar players. We excluded quotations when we could not identify who or what was being quoted.

**Analyze quotations** We analyzed quotations in two different ways. First we selected the most-quoted position that was not from the Cochrane Review and categorized how it was discussed in the news articles. Then we used polylogue analysis, filtered to the most-quoted players, to illustrate how players agreed and disagreed with each other.

To construct a specific polylogue diagram, our filtering process was:

- 1. Choose players who were quoted in at least four news articles.
- 2. Group the direct quotations that are sourced from the same news article or video together and choose a representative position.
- 3. When a player has multiple positions supporting or attacking the same player, we select a representative position for the diagram.

#### DEMASI: Did you wear a mask?

JEFFERSON: I follow the law. If the law says I need to wear one, then I wear one because I have to. I do not break the law. I obey the law of the country.

#### DEMASI: Yeah, same. What would you say to people who still want to wear a mask?

JEFFERSON: I think it's fair to say that if you want to wear a mask then you should have a choice, okay. But in the absence of evidence, you shouldn't be forcing anybody to do so.

DEMASI: But people say, I'm not wearing a mask for me, I'm wearing it for you.

JEFFERSON: I have never understood that difference. Have you?

DEMASI: They say it's not to protect themselves, but to protect others, an act of altruism.

JEFFERSON: Ah yes. Wonderful. They get the Albert Schweitzer prize for Humanitarianism. Here's what I think. Your overnight experts know nothing.

#### DEMASI (laughs)

JEFFERSON: There is just no evidence that they make any difference. Full stop. My job, our job as a review team, was to look at the evidence, we have done that. Not just for masks. We looked at hand washing, sterilisation, goggles etcetera...

Fig. 3. An excerpt from the Substack newsletter "Maryanne Demasi, reports" [13], showing Tom Jefferson's heavily quoted "full stop" position.

# 5 Results

We analyzed 58 news articles published from February 1, 2023 to March 9, 2023 (inclusive). Of these, 57 articles<sup>3</sup> linked to the Cochrane Review and used it in various ways; 41 quoted the Cochrane Review.

# 5.1 The most heavily quoted position that is not from the Cochrane Review

The Cochrane Review's first author, Tom Jefferson, was quoted in 19 articles, most often with the words: "There is just no evidence that they make any difference. Full stop.". We further analyze the 12 articles that contained this comment, which Jefferson made during an interview with Maryanne Demasi posted on her Substack, a digital newsletter platform [13]; an excerpt is shown in Figure 3.

It is difficult to determine whether "they" refers to masks or mask mandates. News authors seem to interpret Jefferson's "they" to mean "masks to prevent COVID-19" [60] or "mask mandates to prevent COVID-19" [28]. Yet in the interview, Demasi and Jefferson were turning at this point from current

<sup>&</sup>lt;sup>3</sup> While selected for linking to the Cochrane Review, due to altmetric.com data errors, one [71] did not in fact link to the Cochrane Review.



**Fig. 4.** Context is lost as we go from the Cochrane Review conclusions to statements in Jefferson's full interview with Demasi to his "full stop" position. In particular, the uncertainty stated in the Cochrane Review becomes "no evidence...Full stop..." [13].

events (presumably specific to COVID-19) back to the Cochrane Review, which concerns respiratory diseases in general.

The phrase "full stop" indicates certainty—the facts are in and the case is closed—and some news authors take such certainty to refer to "no evidence." However, "full stop" in Jefferson's reply is scoped: it must refer to evidence relevant for inclusion in the Cochrane Review, from words such as "...as a review team...we looked at" [13]. In the same interview, Jefferson made multiple statements about masks, mask mandates, and the related evidence base, at times with much more nuance. For example, after Demasi asked for a clarification about Jefferson's "full stop" position, Jefferson said [13], "there's no evidence that they do work, that's right. It's possible they could work in some settings...we'd know if we'd done trials." Compared to the "full stop" position, Jefferson's clarification provides more context by emphasizing what is missing in the current evidence base on mask effectiveness. However, perhaps due to its ambiguity, this more detailed statement was not mentioned in the 12 news articles that quoted Jefferson's "full stop" position.

Caveating the evidence considered is particularly important. The Cochrane Review indicates uncertainty about either effectiveness or ineffectiveness according to their evidence base [33]: 'We are uncertain... based on the [randomized controlled trial] studies...we assessed." Yet instead, Jefferson's "no evidence...full stop..." removed the uncertainty from the Cochrane Review conclusions, as shown in Figure 4. Compared to the Cochrane Review conclusions, the "full stop" position does not emphasize the uncertainty about the evidence stressed in the Cochrane Review. Instead, Jefferson's language, especially "full stop," suggests that the evidence we currently have is conclusive. We call this decontextualization.



**Fig. 5.** A Fox News article [37] replaced the Cochrane Review conclusions with Jefferson's words from an interview with Maryanne Demasi [13].

Jefferson drew on his experience as first author of the 2006 protocol and five versions of the Cochrane Review since 2007, with particular specifications for the evidence to be considered (see Section 3.3). The absence of evidence was a continued point in the interview [13]: "I keep saying it repeatedly, it needs to be looked at by doing a huge, randomised study – masks haven't been given a proper trial." A particular challenge is distinguishing the absence of evidence from the evidence of absence; this is an important but little-covered distinction. Absence of evidence that "masks are effective" does not, in fact support the opposite conclusion, "masks are ineffective." While neither definitively excludes the conclusion that "masks don't work," the Cochrane Review's key message would be clearer to someone who understands that absence of evidence is not evidence.

How the news quoted Jefferson's "full stop" position The twelve articles quoting Jefferson's "full stop" position used it in four ways, as shown in Table 1: replacing, associating, distinguishing, and simplifying. Six articles replace the Cochrane Review; one example is shown in Figure 5. In three articles, the Cochrane Review conclusions were not explicitly stated, but Jefferson's "full stop" position is distinguished from the review conclusions. For instance, according to the *Los Angeles Times* [44]: "The biggest problem with Jefferson's statement about masks is that it's profoundly at odds with the data in the very paper carrying his name." Another three articles use Jefferson's "full stop" position after presenting the Cochrane Review conclusion, to simplify it. Finally,

Category	Number	Example
	of news	
	articles	
Replacing	5	"The conclusion about masks: 'There is just no evidence
		that they make any difference. Full stop,' Tom Jefferson,
		the study's first author, said in an interview." [37]
Distinguishing	3	"The biggest problem with Jefferson's statement about
		masks is that it's profoundly at odds with the data in
		the very paper carrying his name." [44]
Simplifying	3	"The Cochrane Database of Systematic Reviews, a re-
		spected biomedical journal, surprised the public recently
		with a peer-reviewed article raising doubts about the ef-
		fectiveness of wearing face masks and respirators during
		the pandemic. An author of the study, Tom Jefferson of
		the University of Oxford, declared of face masks in an in-
		terview" [9]
Associating	1	"There is just no evidence that they make any difference.
		Full stop,' Oxford epidemiologist Tom Jefferson concluded
		after he and 11 colleagues completed the most rigorous and
		extensive review of mask wearing to date." [12]

Table 1. Jefferson's "full stop" position is quoted in four different ways.

one article, from *The Hill*'s opinion section, associates the "full stop" position with the Cochrane Review, as what Jefferson "concluded after" [12] authoring the review without quite using Jefferson's statement to replace the Cochrane Review's conclusion. Associating or replacing the Cochrane Review conclusions aggravated the decontextualization process illustrated in Figure 4 as we next describe.

Figure 5 illustrates how one news article [37] replaced the Cochrane Review conclusions ("The conclusion about masks") with Jefferson's "full stop" position, misstating the conclusions and obscuring the uncertainty of the evidence. Specifically, the article [37] presented Jefferson's "full stop position" as the Cochrane review's conclusion. They list Jefferson's words after "The conclusion about masks:" as though these words were directly quoted from the Cochrane Review, while in fact they were from its first author. The assertion "no evidence" is not caveated.

Decontextualization seems to explain how some news arrived at what Cochrane called an 'inaccurate and misleading interpretation' [57]. This occurred 5 times in our sample, as shown in Table 1. Yet the uncertainty about the effectiveness of mask-wearing stated in the Cochrane Review left room for different interpretations of whether or not America needed mask mandates.

Player name Player group		Biography	News
			articles
The Cochrane	The Cochrane	A high-profile medical review	41
Review	Review		
Tom Jefferson	Authors of the	First author of the Cochrane Review	19
	Cochrane Review		
Bret Stephens	Journalists	A New York Times Op-Ed columnist	13
Robert Redfield	Government	Former director of the US Centers for	6
	agency	Disease Control and Prevention	
	representatives	(CDC)	
Anthony Fauci	Government	Former chief medical advisor to the	4
	agency	President of the US and the former	
	representatives	director of the National Institute of	
		Allergy and Infectious Diseases	
		(NIAID)	
Michael	Scientists	Director of the Center for Infectious	4
Osterholm		Disease Research and Policy	
		(CIDRAP) and Regents Professor at	
		University of Minnesota (UMN)	
Lisa Brosseau	Scientists	Retired professor of environmental	4
		and occupational health sciences from	
		the University of Illinois Chicago, and	
		a research consultant with CIDRAP	
		at UMN	
Andrejko et al.	Research	A publication about the effectiveness	4
2022	publications <sup>1</sup>	of mask-wearing	
Rochelle	Government	Former director of the US CDC	3
Walensky	agency		
	representatives		
US CDC	Government	US Centers for Disease Control and	3
	agencies	Prevention	
Health Feedback	Other groups	A fact-checking organization	2

 $^{1}$  One legal statute also belongs to the research publications player group [74].

**Table 2.** The players quoted in the largest number of news articles. We show at least one player from 8 of the 9 player groups we identifed. The player group not shown is "other individuals."

# 5.2 Polylogue analysis of the Cochrane Review

We we annotated 100 players and 337 positions from the 58 news articles in our sample. Table 2 shows example players from 8 of the 9 player groups we identified; "other individuals" (not shown) is the ninth player group.

The news brought together the words of multiple different players, including the Cochrane Review itself, as shown in our polylogue diagram, Figure 6. Players' positions are connected with support (green solid arrows) and attack (red dashed lines ending in  $\times$ 's) relationships.

The news pointed out that not all studies were eligible for inclusion in the Cochrane Review. Figure 6 shows one such study [5].

Evidentiary standards were taken up in multiple ways. The observational study [5] mentioned by an outlet called *Reason* [64] was not acceptable according to the Cochrane Review's inclusion criteria (Section 3.3). The observational study determined that "people who reported always wearing a mask in indoor public settings were less likely to test positive for COVID-19 than people who didn't" [5], whereas the Cochrane Review concluded, "There is uncertainty about the effects of face masks" [33]. These two publications, shown as players in Figure 6, have contradictory conclusions.

Michael Osterholm and his colleagues criticized the Cochrane Review in a commentary by arguing that "the Cochrane review authors incorrectly combined studies where people wore masks or respirators infrequently with those where they were worn all the time" [40].

Bret Stephens's *New York Times* opinion article [60] argued "mask mandates did nothing" by quoting the interview with Cochrane Review first author Jefferson analyzed above [13]. In that interview, Jefferson also criticized government agency representatives such as Fauci.

Government representatives and scientists showed different understandings of mask-wearing over time as the scientific evidence base changed, leading to contradictions in positions made at different stages of the COVID-19 pandemic, as shown in Figure 6. In March 2020, before clear scientific evidence that maskwearing for the public might be effective, and in the wake of mask shortages, Dr. Anthony Fauci stressed that masks cannot "provide the perfect protection that people think that it is" [1]. However, Redfield's position in September 2020 was [67]: "face masks are the most important powerful health tool we have." Both these positions were quoted in the news, suggesting that the epistemic uncertainty itself was newsworthy. The *Daily Mail* wrote "The debate around masks first turned sour in 2020 when health officials flip-flopped on their effectiveness." [66]. The *Daily Mail*'s article, titled "Masks make 'little to no difference' to Covid infections, massive study finds," contrasted the "flip-flop" in governmental positions with an impression of newfound certainty from the Cochrane Review.



**Fig. 6.** Support (green solid arrows) and attack (red dashed lines ending in  $\times$ 's) relationships between players' positions.

# 6 Discussion

The Cochrane Review we analyzed was salient for the news media reporting on the effectiveness of mask-wearing towards the end of the US federal COVID-19 Public Health Emergency. The news we analyzed quoted players with competing interpretations of the Cochrane Review as shown in Figure 6. Polylogue analysis's capacity for handling quotations in a natural way is one of its strengths: summarizing how positions made by multiple players are discussed helps analyze news commentary about controversial scientific topics.

As we discussed in Section 5.1, the frequently-quoted "full stop" position from Cochrane Review first author Tom Jefferson was used to argue that masks made no difference, and potentially may have been taken as a full and faithful representation of the review's conclusions. By contrast, the Cochrane Review concluded [33] "we are uncertain whether wearing masks or N95/P2 respirators helps to slow the spread of respiratory viruses based on the studies we assessed." The Cochrane Review also clearly stated its limitations [33]: "The high risk of bias in the trials, variation in outcome measurement, and relatively low adherence with the interventions during the studies hampers drawing firm conclusions."

Cochrane followed up the news we analyzed with a March 10, 2023 statement [57]: "Many commentators have claimed that a recently-updated Cochrane Review shows that 'masks don't work', which is an inaccurate and misleading interpretation." As of this writing, ten months after that Cochrane statement, the review has not been updated to remove the phrase called out in [57]: "We are uncertain whether wearing masks or N95/P2 respirators helps to slow the spread of respiratory viruses based on the studies we assessed." [33], which is the key message provided as the top line of the Cochrane Review's 2-page plain language summary shown in Figure 1 above.

### 6.1 "Reasonable disagreement" on evidentiary standards

The epistemic uncertainty stated by the Cochrane Review left room for "reasonable disagreement" [6]. Scientists can and do make different decisions about what kind of evidence is convincing. Health scientists had gathered complementary evidence (see e.g. [22]) even as of May 2020, during the review period for the November 2020 Cochrane Review. In 2021, Walensky's position was [68], "The evidence is clear. Masks can help prevent the spread of COVID-19 by reducing your chance of infection by more than 80 percent."

Likewise, the public may call the scientific community to account when scientists' accounts do not convince them. For instance, Jackson & Lambert ask "what it will take to get citizens to believe that there really is no autism epidemic" [30], and argue that the scientific community needs to produce more convincing evidence to respond to reasonable concerns from citizens about possible environmental contributions to the growth in autism. They see open access, proliferation of information, and search engines as contributing to the vaccine controversy, noting that [30], "In the new media ecology, the public is equipped to demand a much more active role in getting science done on questions it considers important."

Experiments such as the "huge, randomised study" Jefferson suggested [13] could help convince scientists like him, and likely the public as well. In particular he wished we had "randomised half of the United Kingdom, or half of Italy, to masks and the other half to no masks" [13]. Aside from prioritizing evidence generation, further discussion of why specific evidence is or is not sufficiently convincing, to scientists or to the public, could further clarify differences in evidentiary standards.

#### 6.2 Decontextualization of information is problematic

We traced how the news decontextualized the Cochrane Review and its conclusion. Statements made by Tom Jefferson, first author and the most heavily quoted player besides the Cochrane Review, were successively removed from context as we showed in Figure 4. Jefferson's words "There is just no evidence that they make any difference. Full stop." [13], suggested certainty and allowed for multiple interpretations of "they." Among the twelve articles that quoted this position, five used it to replace the Cochrane Review conclusions, as we illustrated in Figure 5.

Bekler et al. described "decontextualized truths" as a challenge of political information [7]. For epistemically uncertain science topics, "decontextualized scientific evidence" is more apt due to the inherent falsifiability of current scientific 'truths'. Decontextualization of information is an important aspect to consider in future studies of information disorder. It does not neatly fit into the current definition of information disorder: misinformation ("content that is false but not intended to harm"), disinformation ("content that is false and intended to harm"), and malinformation ("truthful information that is intended to harm") [70]. Even without intention to harm, such decontextualized information can be problematic.

When journalists try to simplify scientific information, they need to be wary of oversimplification, such as loss of context and caveats. This is challenging due to the "ambiguity of boundary between appropriate simplification and distortion" when science travels downstream from its producers [26, page 530]. However, special attention is essential since the decontextualization of scientific evidence may worsen scientific controversies.

# 6.3 Comparison to information and communication research about COVID-19

Our work also contributes to the body of information and communication research about masks and COVID-19. Among the most similar research, Fernandes [17] focused on uncertainty and risk communication using an STS-infused qualitative discourse analysis; his data were three US, UK, and European news articles reporting the WHO's changes to COVID-19 advice on masks, smoking, and asymptomatic transmission. Bogomoletc et al. [10] analyzed how Twitter

and news media cited six articles about mask efficacy to support both pro- and anti-mask positions at the beginning of the COVID-19 pandemic.

Our work complements existing international research about COVID-19 in the news by providing a late-pandemic, US perspective. O'Connor et al. [48] analyzed news articles related to COVID-19 and science from the island of Ireland early in the pandemic. Their qualitative analysis of 952 articles published between January and May 2020 identified three main themes: portrayal of the science process; positive and negative relationships with science; and the utility of science. Schultz and Ward [55] analyzed 670 news articles from France published between January and April 2020 relating to the drugs chloroquine or hydroxychloroquine, coding discussions about efficacy, prescribing, the practice of science. While both O'Connor et al. and Schultz and Ward collected news from the first few months of the pandemic, our news data was US-associated news collected late in the pandemic, a few months before the end of the US Public Health Emergency. With our smaller dataset we conducted a fine-grained analysis of specific arguments by examining quotations.

### 6.4 Implications for altmetrics data quality analyses

In our case study, we observed at least three of the 14 specific altmetrics news data error types described by Yu et al. [73]:

- 1. Source news article has been deleted by the news platform
- 2. News link provided by Altmetric.com does not have attached hyperlink and specific news title is not provided
- 3. False positive news mention due to unknown reason

We also found two additional types of missing articles beyond the news almetrics errors described in Yu et al.'s analysis [73]: First, we found articles omitting the original version of a news article despite the inclusion of multiple versions from news aggregators. Second, we found missing articles that indirectly cited the Cochrane Review, such as Vox.com's "The new scientific review on masks and Covid isn't what you think" [51], which links to Cochrane's abstract-only page [32] for the Cochrane Review, rather than to the article itself.

# 6.5 Limitations

Our analysis mainly focused on two of the three concepts of polylogue analysis. The third concept, places, which concerns when and where arguments appear, was minimally used in selecting our data. Consideration of the temporal aspect of places would have helped better represent our data, particularly for government representatives whose positions changed over time.

We have only analyzed news published before March 10, 2023; we did not consider later news such as corrections or follow-up articles. When we collected articles on August 1, 2023, Altmetric.com identified 396 news articles as referring to the Cochrane Review; this number continues to increase and stands (as of December 26, 2023) at 480.

#### 6.6 Future work

Our future analysis will incorporate the polylogue analysis concept of places [39], including where and when the arguments appeared, and who was a bystander versus a ratified participant. The temporal aspect of places would be particular valuable for contextualizing crisis information and epistemic uncertainty in the future. Places could also incorporate the news venues, so we will combine our polylogue analysis with Ad Fontes<sup>4</sup> ratings of different news venues' reliability and left/right political bias to understand the extent to which positions correlated with partisanship of the venues in which they appeared.

We will examine the 16 news articles that linked to the Cochrane Review without directly quoting it to determine whether these articles decontexualized the Cochrane Review conclusions. Since the first author's words often replaced the review conclusions, we will also check how he was quoted in the seven news articles that quoted him without quoting his "full stop" position.

Given the many choices for filtering quotations, we will experiment with the number of players and positions considered in our future polylogue analyses. For diagramming players and positions, automatic filtering tools would be particularly helpful for enabling exploratory analysis.

News about science has been shown to impact public health-related behavior [45]; future work should quantify the extent to which news about the effectiveness of mask-wearing impacted public behavior. In future work, we will analyze how the public responded to the Cochrane Review indirectly by referring, on social media, to news articles quoting it, using Alperin et al.'s concept of second-order citations [3]. We especially would like to understand what the public took from the review's conclusions and what policy actions the public thinks the Cochrane Review justified.

# 7 Conclusions

We presented a case study about how US news articles published discussed a controversial Cochrane Review about the effectiveness of mask-wearing late in the US federal COVID-19 Public Health Emergency. Epistemic uncertainty of the review conclusions was difficult to express in simple ways that wider public audiences could understand. In particular, due to epistemic uncertainty, multiple contradictory positions can coexist as credible. Future work on information disorder in science needs to consider not only the intention to harm, but also risks associated with oversimplification or decontextualization of current scientific evidence.

# 8 Data Availability

Excerpts from the news articles used in our MAXQDA analysis and a spreadsheet of the data used from Altmetric.com are available in the following dataset:

<sup>&</sup>lt;sup>4</sup> https://adfontesmedia.com/

Heng Zheng and Jodi Schneider (2023): Dataset for "Arguing about Controversial Science in the News: Does Epistemic Uncertainty Contribute to Information Disorder?". University of Illinois at Urbana-Champaign. https://doi.org/ 10.13012/B2IDB-4781172\_V1

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- Theodore Dreyfus Ledford: Conceptualization, Writing original draft, review & editing
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