Do Conspiracy Theories and Misinformation Cause Vaccine Hesitancy and Refusal?

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Abstract: Nearly one hundred published studies demonstrate that beliefs in COVID-19 conspiracy theories and misinformation are negatively associated with COVID-19 preventive behaviors. These correlational findings are often interpreted as evidence that beliefs in conspiracy theories and misinformation are exogenous, causal factors prompting people to, for example, forgo vaccination. This interpretation has motivated researchers to develop methods for "prebunking," "debunking," or limiting the spread of online conspiracy theories and misinformation. However, the robust literatures on conspiracy theory beliefs, health behaviors, and media effects lead us to question whether beliefs in conspiracy theories and misinformation should be treated as causal factors, exogenous to vaccine hesitancy and refusal. Employing U.S. survey data (n=2,065) from July 2021, we show that beliefs in COVID-19 conspiracy theories and misinformation are not only related to COVID-19 vaccine hesitancy and refusal, but also strongly associated with the same psychological, social, and political motivations theorized to drive COVID-19 vaccine hesitancy and refusal. By showing that beliefs in conspiracy theories and misinformation are less of an exogenous cause and more of a manifestation of the same factors that lead to vaccine hesitancy and refusal, our findings suggest that many policymakers, journalists, and scholars should recalibrate efforts to address vaccine refusal. We conclude by encouraging researchers to refocus on the worldviews, personality traits, and political orientations that belie both health-related behaviors and beliefs in conspiracy theories and misinformation.

Significance Statement: It is imperative that scholars, practitioners, and policymakers understand the factors driving COVID-19 vaccine refusal so that interventions aimed at increasing uptake can be appropriately deployed. Because numerous studies show that beliefs in COVID-19 conspiracy theories and misinformation are negatively associated with vaccine uptake, many scholars assume that online conspiracy theories and misinformation persuade individuals to forgo vaccination. However, there exists little causal evidence for this proposition and robust research literatures cast doubt on this assumption. Our analyses show that COVID-19 vaccine hesitancy and refusal are likely borne of the same factors that foster beliefs in COVID-19 conspiracy theories and misinformation, suggesting that beliefs in conspiracy theories and misinformation are more of a marker than a cause of vaccine refusal.

Since the beginning of the COVID-19 pandemic, conspiracy theories and misinformation (CTM) have been a prime concern of researchers across disciplines (1), and for good reason: a wealth of research consistently demonstrates a strong negative relationship between beliefs in pandemic-related CTM and disease-preventive behaviors, including vaccine refusal (2). Thus, many scholars have come to believe that the spread of CTM represents a "crisis situation" (3) or "infodemic" as dangerous as the pandemic itself (4). One characteristic of this research is the assumption of a specific causal link: that beliefs in CTM *cause* vaccine hesitancy and refusal.

This assumption has become influential in discussions of COVID-19 CTM. It has motivated researchers to develop methods for pre-bunking (5) and debunking (6) beliefs in CTM, and has led researchers to call for the "downgrading, blocking, and counteracting," of online CTM (7). Journalists and politicians similarly blame CTM for deleterious beliefs and behaviors (8): members of Congress have proposed legislation for regulating CTM on online platforms (9) and U.S. President Joe Biden claimed that online CTM was responsible for "killing people" (10).

While we do not challenge the observed correlations between beliefs in CTM and vaccine hesitancy and refusal, we do question their substantive interpretation. We argue that beliefs in CTM should not be conceptualized or modeled as fully exogenous, causal antecedents of vaccine hesitancy and refusal. This is because the psychological, social, and political motivations—as well as event-specific environmental factors—that promote vaccine-related attitudes and behaviors have also been found to promote beliefs in CTM. For example, a lack of trust in the scientific community may drive individuals to eschew the COVID-19 vaccine and concurrently to adopt beliefs in CTM. Thus, beliefs in CTM may be endogenous rather than causal.

To detail our argument, we draw on the foundational literatures addressing media effects, beliefs in CTM, and health-related beliefs and behaviors, all of which suggest that 1) beliefs in

CTM are unlikely to be causally antecedent to vaccine attitudes and behaviors, and that 2) exposure to CTM in the information environment is unlikely to, on its own, be persuasive. To demonstrate our argument, we employ U.S. survey data from July 2021 (n=2,065) measuring beliefs in COVID-19 CTM and vaccine hesitancy and status. A factor analysis shows that beliefs in COVID-19 CTM and vaccine hesitancy can be conceived of as sharing a single dimension of opinion and are sufficiently correlated that distinguishing between them is difficult. Next, we explore the role of COVID-19 CTM in both the theoretical and empirical models typically used to explain vaccine hesitancy and refusal. We demonstrate that the factors predicting belief in COVID-19 CTM also predict vaccine status and hesitancy, suggesting that beliefs in COVID-19 CTM and vaccine hesitancy and refusal are not causally related as often assumed.

Our conclusions reconcile two growing bodies of literature: one expressing alarm about the role of CTM in driving deleterious attitudes and behaviors (3, 7, 11) and another demonstrating that the influence of CTM on such attitudes and behaviors is limited and conditional (12-15). Simply put, we argue that the factors driving exposure and acceptance of CTM need to be properly accounted for. To claim causality with little evidence is to consequentially misattribute the foundations of vaccine hesitancy and to misdirect efforts at increasing vaccination rates.

The Connection Between COVID-19 CTM and Vaccine Hesitancy and Refusal

Since the onset of the COVID-19 pandemic, scholars have focused on the circulation of CTM about the virus's origins, effects, and treatments, as well as the potential impact of CTM on pandemic-related behaviors (16). The vast majority of these studies—across different disciplines

and focusing on various countries—demonstrate that beliefs in COVID-19 CTM have a strong negative association with pro-social and disease-preventative health behaviors (see review in 2).

The most protective COVID-19 preventive public health measure individuals can partake in is vaccination. Numerous studies demonstrate a negative association between beliefs in COVID-19 CTM and vaccine intentions and status (17-19), providing a potential clue about why vaccination rates in many parts of the world have stagnated. Despite the correlational nature of these studies, negative relationships between beliefs in COVID-19 CTM and COVID-19 vaccine attitudes and behaviors are typically interpreted through a particular causal lens: that vaccine hesitancy is, at least partially, *caused* by (online) exposure to, and belief in, CTM (19-21).

[Figure 1 about here]

The conceptual model in Panel A of Figure 1 details the relationship between beliefs in COVID-19 CTM and vaccine hesitancy and refusal assumed by many scholars, journalists, and policymakers (22): exposure to COVID-19 CTM vis-à-vis media use—especially social media use—leads to beliefs in COVID-19 CTM, which subsequently result in vaccine hesitancy, and finally, vaccine refusal. Under this and similar models, the obvious prescription for boosting vaccination rates involves limiting CTM in the information environment (7), or perhaps inoculating people to such ideas in advance of exposure (5). Adherence to this model has prompted researchers to recommend "aggressive" actions (7) because "unregulated social media may present a health risk" (19). However, three robust bodies of literature provide reason to be suspicious of the presumed causal pathway depicted in Panel A of Figure 1.

First, a wealth of research on the causal antecedents of beliefs in CTM conceives of such beliefs as the product of deep-seated psychological, social, and political motivations, with exposure sometimes playing a more limited, conditional role (23). Thus, beliefs in CTM should

be treated as the downstream products of more foundational characteristics, not as explanatory factors in and of themselves. This theoretical perspective follows widely accepted and evidenced models of both health and political belief formation: peoples' worldviews, ideologies, values, group attachments, personalities, and even occasionally biological and genetic factors—the relatively stable features of our identities—are the primary ingredients of beliefs regarding politics, health and medicine, and various forms of CTM (24, 25). Thus, both beliefs in COVID-19 CTM and pandemic-related behaviors share many underlying (presumably causal) ingredients.

For example, conspiracy mentality (26, 27), scientific literacy and trust in science (28, 29), political ideology and partisan attachments (16, 30), social media use (7), personality traits (31, 32), and emotional conditions, such as stress and anxiety (33, 34), have been found to predict *both* beliefs in COVID-19 CTM and pandemic-related behavioral intentions. Further, whereas Panel A of Figure 1 suggests a recent cause (exposure to COVID-19 CTM) for beliefs in COVID-19 CTM and vaccine refusal, vaccine CTM and refusal are hardly new social problems. Robust literatures document longstanding opposition to vaccines (and medical science, more generally), showing that those attitudes are likely borne of the same factors linked to opposition to COVID-19 vaccines (35-37). Thus, for many people, refusal to vaccinate for COVID-19 is likely a consequence of motivational factors that preexist exposure to COVID-19 CTM and even the COVID-19 pandemic itself.

These points come into focus when considering the implied influence of information exposure detailed in Panel A of Figure 1. The causal influence of exposure to COVID-19 CTM from the mainstream or social media, or from elsewhere, suggests a "hypodermic needle" effect, whereby (incidental) exposure directly promotes belief (38). However, a century-long literature

suggests that media effects are limited, conditional on individual and environmental factors, and, most importantly, partially endogenous to beliefs, themselves (39).

Selective exposure and avoidance—the tendency for individuals to seek out information that comports with previously held beliefs, or ignore that which is incongruent with said beliefs (40)—are more prominent models of media effects than hypodermic models. Selective exposure also guides the search/avoidance for, and acceptance/rejection of, CTM, specifically: people drawn to conspiracy theories tend to seek them out, and individuals not attracted to conspiratorial explanations avoid them (41). The same can be said of vaccine skeptical content: very few people not exhibiting vaccine hesitant attitudes choose to consume vaccine skeptical content (42). Even for individuals who are incidentally exposed to CTM, previously held dispositions and beliefs will temper their willingness to be persuaded through processes such as motivated reasoning (43). Thus, we possess additional reasons to expect that exposure to CTM—regardless of medium—might serve merely as reinforcement for, or as an expression of, previously held beliefs, values, and predispositions, rather than an impetus for individual change.

In light of past work, we propose an alternative model of vaccine hesitancy and refusal in which pre-existing social, political, and psychological motivations are key to understanding vaccine hesitancy and refusal in Panel B of Figure 1. This model, while containing the same elements as Panel A, better incorporates past theories and empirical findings regarding the causes of beliefs about CMT and vaccines. In this model, both beliefs in COVID-19 CTM and vaccine hesitancy are promoted by social, political, and psychological motivations; those motivations in Panel B, then, largely replace the assumed foundational role of exposure to COVID-19 CMT vis-à-vis exposure in Panel A. For example, those who distrust doctors and scientists are more likely to concurrently hold vaccine hesitant attitudes *and* believe in COVID-19 CTM. This not only

better incorporates the literature on the foundations of beliefs in CTM and vaccine hesitant attitudes, but more accurately accounts for well-evidenced theories of media effects.

The model in Panel B also allows for a reinforcing relationship between beliefs in COVID-19 CTM and vaccine hesitancy. Because of the tendency for individuals to reinforce their beliefs and identities, vaccine hesitancy might strengthen and expand beliefs in CTM, just as beliefs in CTM may strengthen and expand vaccine hesitancy. This reciprocal relationship allows for the possibility of beliefs in COVID-19 CTM to be adopted *after* an individual is vaccine hesitant, a scenario in which CTM serve as a rationalization, rather than a motivating force, for attitudes and behaviors. This process comports with scholarship showing that people will often adopt beliefs in CTM to justify pre-existing views in the face of disconfirming evidence or use CTM to rationalize personal or political losses (44). Panel B is also consistent with individuals who base their vaccine hesitancy on, rather than CTM, a stylized interpretation of authoritative facts (45) (e.g., the COVID-19 vaccine is 'not yet fully approved'), and also with pro-vaccine individuals who share beliefs in various CTM (46). Exposure to and beliefs in COVID-19 CTM in Panel B are, therefore, neither necessary nor sufficient for the adoption of vaccine hesitant attitudes or vaccine refusal.

An Empirical Illustration

Data

Our central argument is that beliefs in COVID-19 CTM are better thought of as endogenous to vaccine hesitancy and behavior, rather than strictly exogenous and causal. Therefore, our empirical examination is designed to demonstrate the plausibility of Panel B of Figure 1. We utilize a unique national survey containing questions about COVID-related CTM, as well as questions designed to measure a wealth of psychological, social, and political traits and

orientations previously found to promote beliefs in CTM (23). These include: science literacy, trust in scientists and health professionals, Machiavellianism, narcissism, psychopathy, perceived victimhood, stress, conflictual behavior, conspiracy thinking, partisanship, ideology, support for Donald Trump, and social media usage, in addition to age, educational attainment, religiosity, perceived socioeconomic status, race and ethnicity, and gender. Details regarding question wording, summary statistics, and scale reliability appear in the Supplementary Information (SI).

We partnered with Qualtrics to interview 2,065 U.S. adults between July 17–August 5, 2021. The sample was designed to match the 2019 U.S. Census American Community Survey records on sex, age, race, and education; details about the sociodemographic composition of the sample appear in the SI. This research was approved by the University of Miami Human Subject Research Office on July 14, 2021 (Protocol #20210618). In order to ensure quality, respondents were required to pass four attention checks; these included a mixture of standalone questions and questions embedded in grids, per best practices (47). Participants who failed to pass all four attention checks were excluded from the data set. We also took steps to eliminate "speeders"—respondents who click through a survey without reading the questions. A soft-launch of the survey (n=127) yielded a median time to complete of 11.6 minutes. Participants who completed the questionnaire in less than one-half the median time were excluded from the dataset.

The beliefs in CTM that we utilize appear in Table 1, along with the percentage of respondents who either "agree" or "strongly agree" with each. We observe significant variability in the popularity of these ideas. Both sets of questions were averaged into additive scales of beliefs in conspiracy theories (α=0.90, Range=1–5, M=2.20, SD=1.04) and beliefs in misinformation (α=0.93, Range=1–5, M=2.16, SD=1.06).

[Table 1 about here]

We utilize two dependent variables. The first is self-reported vaccination status. We asked respondents: "Have you personally received at least one dose of a COVID-19 vaccine?" Sixty-eight percent reported having received the vaccine, 32 percent reported not having received it. We also asked those who reported not having received the vaccine: "Which of the following best describes how you feel about the COVID-19 vaccine?" Response options included: "I plan to get the vaccine as soon as possible" (12%), "I am open to it, but will keep waiting and see what happens" (25%), "I will only get the vaccine if required by my job or places I need to go" (12%), and "I definitely will not get the vaccine" (51%). For this dependent variable, we coded as 1 those who received the vaccine and those who reported a plan to get the vaccine as soon as possible (72%); those who had not received the vaccine and were either unwilling or had no immediate intention of being vaccinated (28%) are coded 0. We also estimated the models below using only the initial question about vaccination status where only those who have not been vaccinated and are completely unwilling to be vaccinated are coded as 0. Results are substantively identical to those provided below.

Our second dependent variable is an additive scale of attitudes about vaccines (48), coded such that greater values reflect stronger vaccine hesitancy (α=0.91, Range=1–5, M=2.34, SD=0.83). Example questions include the following: "Getting vaccines is a good way to protect me from disease" and "I do not need vaccines for diseases that are not common anymore." The correlation between this measure of vaccine hesitancy and vaccination status is -0.62 (p<0.001).

Results

We begin our analysis by examining the results of an exploratory factor analysis of the items composing the conspiracy theory, misinformation, and vaccine hesitancy scales described above. If each of these constitute distinct dimensions of opinion, we should find that a three-

factor solution best accounts for the correlational structure in the data, and that the specific items belong to each scale are systematically grouped across those factors. Before estimating the factor model, we conducted Horn's parallel analysis for guidance on the appropriate number of factors to retain; this analysis suggested that two factors are appropriate. We also examined a scree plot (see SI), which prompts the same conclusion (the "elbow" appearing at the third factor suggests a two-factor solution).

We estimated the two-factor solution using iterated principal axis factoring; (unrotated) factor loadings and other details appear in Table 2. We bolded the greatest loading in absolute value associated with each item. In each case, the greatest loading is associated with the first factor, usually by a considerable discrepancy. The eigenvalue associated with the first factor is also approximately six times greater than that associated with the second factor. These results suggest that vaccine hesitancy can be conceived as occupying a dimension of opinion along with beliefs in COVID-19 CTM.

Of course, this result does not indicate that COVID-19 CTM beliefs and vaccine hesitancy are synonymous, nor does it mean that we should ignore beliefs in COVID-19 CTM when investigating vaccine hesitancy. It does mean, however, that these beliefs, as measured, are so highly correlated that they would be difficult to disentangle. Unidimensional structure is frequently a primary criterion to meet in the process of successfully creating and validating a psychometric scale—applying the same standard here, we could justifiably create an "anti-vax" scale composed of beliefs regarding COVID-19 CTM *and* vaccines that captures a single (category of) attitude. Thus, predicting COVID-19 vaccine hesitancy with beliefs in COVID-19 CTM is not illuminating as it amounts to a tautology: predicting one operationalization of a construct with another operationalization of the same construct.

[Table 2 about here]

Next, we showcase different strategies for modeling vaccine hesitancy and behaviors. We first demonstrate how beliefs in CTM are typically modeled in the social scientific literatures that empirically examine COVID-19 behavioral intentions. Table 3 contains the (abbreviated) results of two such models. We include all psychological, social, and political factors described above. This group of explanatory factors is more comprehensive than any studies of which we are aware.

[Table 3 about here]

We observe significant positive relationships between our two dependent variables and conspiracy thinking, ideology, Trump approval, psychopathy, perceived victimhood, and conflictual behavior. We observe significant negative relationships with science literacy, trust in scientists, and stress. Interestingly, we do not observe a relationship between beliefs in CTM and time spent on social media. This finding comports with recent work arguing that beliefs in COVID CTM are more than the product of exposure alone (42). That said, we observe significant bivariate correlations ($p<0.001$ in every case) between each variable included in Table 3 and beliefs in CTM; see SI.

Altogether, a litany of traits, orientations, and motivations are presumably exogenous to, and formative of, beliefs in COVID-19 CTM. Indeed, most of these relationships were discovered prior to the COVID-19 pandemic and will presumably prove relevant after the COVID-19 pandemic has passed. This leads us back to our argument about modeling vaccination hesitancy and refusal: the foundational factors behind beliefs in CTM should be the focus of researchers seeking to understand vaccine hesitancy and refusal, not beliefs in specific CTM that are tethered to a particular event and are, themselves, the product of many of the same foundational factors.

Columns 1 and 3 of Table 4 present typical models of vaccine hesitancy and refusal that seek to understand the role of beliefs in COVID-19 CTM. Beliefs in CTM are treated as presumably exogenous independent variables, along with controls for sociodemographic factors (included in the models but omitted from Table 3). In both cases, as with previous work, we observe statistically significant estimates for beliefs in CTM.

[Table 4 about here]

While these models show evidence for hypothesized relationships, we have provided theoretical and empirical arguments about why they are not particularly informational for researchers seeking to understand the psychological antecedents of vaccine hesitancy or those working to develop strategies to encourage vaccination. We present more theoretically powerful models of vaccine-relevant attitudes and behaviors in columns 2 and 4. Here we have replaced beliefs in COVID-19 CTM with the predictors of those beliefs. In doing so, we observe statistically significant relationships with conspiracy thinking, science literacy, trust in scientists, social media use, partisanship, ideology, Trump approval, and narcissism—the same factors driving beliefs in CTM in Table 3. These findings underscore how vaccine hesitant attitudes and behaviors are more than the mere product of beliefs in CTM about vaccines or COVID-19: they appear to stem from deep-seated predispositions, distrust science and medicine, entrenched partisan and ideological commitments, and fundamental personality traits.

A perusal of open-ended responses to the question, "Are there any other reasons why you have not received the COVID-19 vaccine?" offered to the unvaccinated in our survey further illustrates our argument. Some respondents—even those who point to specific CTM—mention *longstanding* views about the government, ("I am a person who is awake to the government's agenda to depopulate the world by poisoning people with vaccines through the years. There has

never been a reason to have a vaccine"), religion ("I Trust God not science and believe this is part of the Mark of the Beast"), and medicine ("Don't believe in vaccines in general," "I am against all vaccines they are toxic poisonous used to control population use aborted fetal cells and no vaccines protect you," "I don't even receive the flu shot") that likely predate COVID-19. Such reasoning suggests that recent exposure to COVID-19 CTM is not the cause of their vaccine refusal. Furthermore, some respondents point to *factual* information as the reason for not getting vaccinated ("I see vaccinated people getting covid anyway"). Thus, beliefs in COVID-19 CTM are neither necessary for, nor strictly exogenous to, vaccine refusal.

Discussion

The academic response to COVID-19 is unsurpassed in the speed in which it produced important findings under trying conditions. Our intention is not to diminish the great interdisciplinary strides made in explaining why individuals took part in, or eschewed, COVID-19 preventive behaviors. However, the speed of scientific discovery meant that researchers were working concurrently, rather than sequentially, and this may have inadvertently slowed self-critique and challenges to the core assumptions of this rapidly expanding literature. Our investigation confronts the possibility that this literature, by not introspectively considering its modeling decisions, is misattributing blame for vaccine hesitancy and refusal and for other undesirable pandemic-related behaviors, as well.

Understanding whether COVID-19 CTM are causal factors driving vaccine hesitancy and refusal—or, like vaccine hesitancy and refusal themselves, a *symptom* of other causal factors—is not merely a question of statistical modelling. It speaks directly to the measures that are needed to address vaccine hesitancy. If COVID-19 CTM are merely a symptom of another problem,

perhaps one that similarly impacts vaccine attitudes, then efforts to censor or correct CTM beliefs will do little to impact vaccination rates. Indeed, studies suggest that such efforts aimed at removing CTM through government censorship, for example, may actually arouse suspicions, thereby *encouraging* conspiracy theory beliefs (49). Regardless of the impact, schemes at removing or labeling content may inadvertently curtail free speech rights, inhibit the free exchange of ideas needed in a democratic society, and remove from public debate ideas that are potentially true or valuable.

During the COVID-19 pandemic, there has been plenty of easily accessible, high-quality information about the disease and the vaccines, yet vaccine hesitancy persists. This is likely because anti-vaccine attitudes are longstanding, having posed a persistent threat to public health even before social media. We therefore encourage public opinion researchers and psychologists to treat vaccine hesitant attitudes like other beliefs they study. Beliefs—in CTM or the dangers of vaccines—are a product of people's motivations: the foundational ingredients of public opinion that guide which information one accepts and integrates into their belief system, and which they reject, ignore, or explain away. This fundamental argument is consistent across the literatures explaining political opinions (24), health-related beliefs (25), and beliefs in CTM (23). In other words, simply giving people the "right" set of facts does not guarantee that they will adopt desirable beliefs or engage in desirable behaviors (50). If we are interested in understanding the exogenous factors that promote vaccine hesitancy, we must recognize the role of people's motivations, and probe deeper than specific beliefs about a given vaccine or virus.

There are, of course, limitations to our analyses. Given their cross-sectional nature, our findings are more suggestive than indicative of the causal processes for which we are arguing; of course, this is the case for most research on COVID-19 vaccine hesitancy, a challenge that

continues to obscure inferences related to the pandemic. More data, particularly longitudinal, would be invaluable for more robustly testing the plausibility of various hypotheses about causal pathways. Nevertheless, this study's empirical evidence demonstrates that researchers should reevaluate their assumptions about modeling choices, explore additional predictors of vaccine hesitancy, and consult the literatures on media effects, selective exposure, conspiracy theory beliefs, and vaccine attitudes, all of which can provide rich guidance for the COVID-19 case.

The argument that correlation is not causation is neither new nor profound, but it is often ignored, even by the most astute scholars. Our findings—in seeking to remind researchers of this fact—comport with a small but growing chorus of scholars pointing out that the co-occurrence of "persistent vaccine hesitancy" and "widespread misinformation," does not indicate causation (15). As dangerous as vaccine hesitancy is, and as bizarre as vaccine refusal may seem to members of the scientific community, the normal rules guiding human beliefs and behavior still apply. Even though beliefs in COVID-19 CTM—by virtue of their relationship with many normatively undesirable outcomes—make an attractive culprit for resistance to disease-preventative behaviors, they are unlikely to be primary, causal antecedents of those outcomes.

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Figure 1: Two conceptual models of relationship between beliefs in COVID-19 conspiracy theories and misinformation and vaccine hesitancy and refusal.

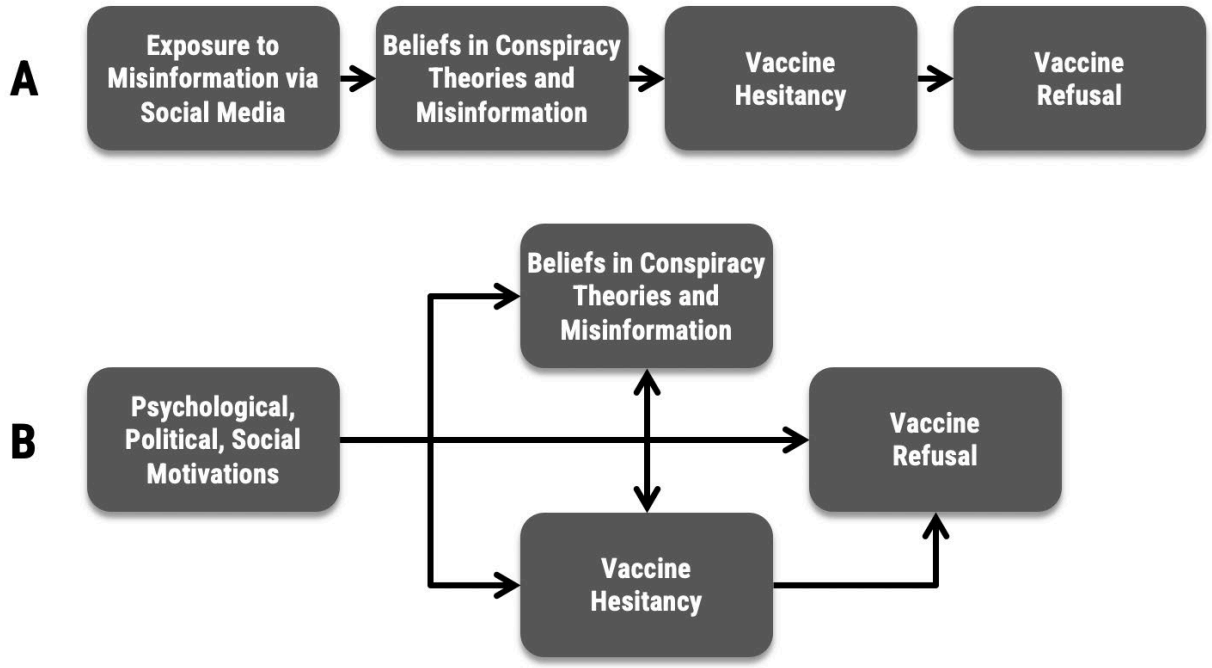

Table 1: Proportion of Americans who believe in COVID-19 conspiracy theories and misinformation.

Conspiracy/Misinformation Belief Question (*Label*)	% Agree
COVID-19 Vaccine Misinformation Beliefs	
1. The COVID-19 vaccine can give you COVID-19. (*Item 1*)	18
2. The COVID-19 vaccine is a scam by the pharmaceutical companies to make money. (*Item 2*)	15
3. The COVID-19 vaccine will alter your DNA. (*Item 3*)	12
4. The COVID-19 vaccine causes infertility. (*Item 4*)	11
5. People receiving the COVID-19 vaccine will "shed" dangerous chemicals from that vaccine. (*Item 5*)	11
COVID-19 Conspiracy Beliefs	
1. The number of deaths related to the coronavirus has been exaggerated. (*Item 1*)	29 25
2. Coronavirus was purposely created and released as part of a conspiracy. (*Item 2*)	25
3. The coronavirus is being used to force a dangerous and unnecessary vaccine on Americans. (*Item 3*)	20
4. The coronavirus is being used to install tracking devices inside our bodies. (Item 4)	12
5. Bill Gates is behind the coronavirus pandemic. (*Item 5*)	11
6. 5G cell phone technology is responsible for the spread of the coronavirus. (*Item 6*)	9

Note: Percentages calculating using “agree” and “strongly agree” responses.

Table 2: Exploratory factor analysis results.

Item	Factor 1	Factor 2	Uniqueness
Vaccine Hesitancy			
Item 1	**-0.737**	0.441	0.263
Item 2	**-0.731**	0.359	0.337
Item 3	**-0.759**	0.398	0.266
Item 4	**-0.680**	0.421	0.361
Item 5	**-0.565**	-0.101	0.671
Item 6	**-0.682**	0.366	0.401
Item 7	**-0.741**	0.413	0.281
Item 8	**-0.612**	0.426	0.445
Item 9	**-0.537**	-0.076	0.706
Item 10	**-0.620**	-0.032	0.614
Conspiracy Beliefs			
Item 1	**0.664**	0.139	0.540
Item 2	**0.695**	0.198	0.478
Item 3	**0.824**	0.194	0.284
Item 4	**0.765**	0.302	0.323
Item 5	**0.720**	0.279	0.404
Item 6	**0.613**	0.339	0.510
Misinformation Beliefs			
Item 1	**0.766**	0.189	0.378
Item 2	**0.822**	0.189	0.289
Item 3	**0.795**	0.227	0.317
Item 4	**0.783**	0.221	0.339
Item 5	**0.774**	0.248	0.340
Eigenvalue	10.682	1.775	
% Variance Explained	85.75	14.25	

Note: EFA estimated using iterated principal axis factoring. Factors are unrotated.

Table 3: OLS regressions of beliefs in COVID-19 conspiracy theories and misinformation on psychological, social, and political factors. Sociodemographic controls omitted from table; see appendix for estimates.

	Beliefs in COVID-19 Misinformation	COVID-19 Conspiracy Theory Beliefs
Conspiracy Thinking	0.219***	0.295***
	(0.019)	(0.017)
Science Literacy	-0.047***	-0.042***
	(0.010)	(0.009)
Trust in Scientists	-0.232***	-0.191***
	(0.015)	(0.014)
Partisanship	0.014	0.010
	(0.010)	(0.009)
Ideology	0.006	0.026*
	(0.012)	(0.011)
Trump Approval	0.004***	0.005***
	(0.001)	(0.001)
Social Media Use	0.017	0.021
	(0.017)	(0.016)
Machiavellianism	0.039	0.033
	(0.022)	(0.020)
Narcissism	0.016	0.036
	(0.021)	(0.019)
Psychopathy	0.171***	0.151***
	(0.024)	(0.022)
Conflict	0.051***	0.050***
	(0.011)	(0.010)
Perceived Victimhood	0.083***	0.084***
	(0.021)	(0.020)
Stress	-0.037	-0.065**
	(0.025)	(0.023)
Constant	2.260***	1.472***
	(0.186)	(0.172)
R^2	0.551	0.605
n	2016	2016

Note: OLS coefficients with standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Models of vaccine hesitancy and non-vaccination status. Sociodemographic controls omitted from table; see appendix for estimates.

	(1) Vaccinated or Planning to Vaccinate	(2) Vaccinated or Planning to Vaccinate	(3) Vaccine Hesitancy	(4) Vaccine Hesitancy
COVID Misinformation	-1.169***		0.349***	
	(0.097)		(0.019)	
COVID Conspiracy Beliefs	-0.195*		0.272***	
	(0.092)		(0.019)	
Social Media Use		0.144*		-0.010
		(0.067)		(0.013)
Conspiracy Thinking		-0.368***		0.154***
		(0.076)		(0.015)
Science Literacy		-0.024		-0.021**
		(0.038)		(0.008)
Trust in Scientists		0.639***		-0.314***
		(0.058)		(0.012)
Partisanship		-0.069		0.021**
		(0.040)		(0.008)
Ideology		-0.096*		-0.001
		(0.045)		(0.009)
Trump Approval		-0.007**		0.003***
		(0.002)		(0.000)
Machiavellianism		0.124		0.017
		(0.085)		(0.017)
Narcissism		0.231**		-0.012
		(0.081)		(0.016)
Psychopathy		0.092		0.032
		(0.090)		(0.018)
Conflict		0.005		0.010
		(0.040)		(0.009)
Perceived Victimhood		-0.007		0.027
		(0.083)		(0.017)
Stress		-0.012		0.015
		(0.094)		(0.019)
Constant	1.973***	-3.591***	1.387***	3.639***
	(0.352)	(0.722)	(0.072)	(0.144)
(Pseudo) R^2	0.304	0.301	0.561	0.559
n	2046	2016	2046	2016

Note: Logit coefficients in columns 1-2; OLS coefficients in 3-4. Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$