Conspiracy theories as barriers to controlling the spread of COVID-19 in the U.S.

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A B S T R A C T

Rationale: The COVID-19 pandemic poses extraordinary challenges to public health.
Objective: Because the novel coronavirus is highly contagious, the widespread use of preventive measures such as masking, physical distancing, and eventually vaccination is needed to bring it under control. We hypothesized that accepting conspiracy theories that were circulating in mainstream and social media early in the COVID-19 pandemic in the US would be negatively related to the uptake of preventive behaviors and also of vaccination when a vaccine becomes available.
Method: A national probability survey of US adults ($N = 1050$) was conducted in the latter half of March 2020 and a follow-up with 840 of the same individuals in July 2020. The surveys assessed adoption of preventive measures recommended by public health authorities, vaccination intentions, conspiracy beliefs, perceptions of threat, belief about the safety of vaccines, political ideology, and media exposure patterns.
Results: Belief in three COVID-19-related conspiracy theories was highly stable across the two periods and inversely related to the (a) perceived threat of the pandemic, (b) taking of preventive actions, including wearing a face mask, (c) perceived safety of vaccination, and (d) intention to be vaccinated against COVID-19. Conspiracy beliefs in March predicted subsequent mask-wearing and vaccination intentions in July even after controlling for action taken and intentions in March. Although adopting preventive behaviors was predicted by political ideology and conservative media reliance, vaccination intentions were less related to political ideology. Mainstream television news use predicted adopting both preventive actions and vaccination.
Conclusions: Because belief in COVID-related conspiracy theories predicts resistance to both preventive behaviors and future vaccination for the virus, it will be critical to confront both conspiracy theories and vaccination misinformation to prevent further spread of the virus in the US. Reducing those barriers will require continued messaging by public health authorities on mainstream media and in particular on politically conservative outlets that have supported COVID-related conspiracy theories.

1. Introduction

Because it is highly contagious, controlling the spread of the novel coronavirus COVID-19 requires widescale public adoption of preventive behaviors (Sanche et al., 2020). Understanding the factors that predict the public's willingness to engage in them is required to control the infection. Still, some national leaders have expressed doubt about the potential seriousness of the pandemic. On March 9th, one member of Congress ridiculed the idea that drastic measures were needed by wearing a gas mask to a vote to approve emergency funding for the pandemic (Cummings, 2020). The President also famously stated that the pandemic would be less harmful than the seasonal flu (Montanaro,

2020). At the same time, several popular conservative media hosts and commentators expressed doubts about COVID-19's seriousness and lethality (Jamieson and Albarracín, 2020; Motta et al., 2020).

The inconsistency between public health messaging and that emanating from some prominent media personalities and political leaders made it difficult for the health community to satisfy a key precondition of public preventive behavior—communicate a consensus that such action is needed (World Health Organization, 2008). In earlier epidemics (Singer et al., 2020), when political leaders of one party failed to endorse health recommendations to combat the threat, the public response divided along partisan lines. Similar patterns have unfolded in the COVID-19 pandemic (Allcott et al., 2020; Pew Research Center,

2020).

Complicating matters further, belief in conspiracy theories that attributed a socially significant event, in this case the novel coronavirus, to unknown and sinister actors (Douglas et al., 2019), were circulating within social and traditional media (Funke, 2020; Infotagion, 2020; Lee, 2020). Conspiracy beliefs are likely to undermine the motivation to take action in the current pandemic, in part because they are difficult to rebut (Lewandowsky et al., 2012; Uscinski et al., 2016). Also, belief in any one of them is likely to be associated with belief in others, suggesting that some persons are more susceptible to such beliefs regardless of their content (Douglas et al., 2019). In addition, some conspiracy beliefs have been associated with unsubstantiated fears of vaccination and unwillingness to vaccinate (Hornsey et al., 2020; Jolley and Douglas, 2014). This finding could be especially problematic because vaccinating a high proportion of those susceptible to the coronavirus is one of the surest means of controlling it (Greenwood, 2014). If conspiracy beliefs are associated with mistaken fears about the nature or effects of vaccination, their circulation could undermine the country's ability to bring COVID-19 to heel.

1.1. The current study

As the numbers of deaths from COVID-19 continued to rise, we conducted two surveys with a panel of US adults, the first in late March after national recommendations for preventive action were released, but before mask-wearing was advised, and the second in July after total statewide lockdowns had been lifted. These surveys were informed by a prior national survey conducted early in March 2020 (Jamieson and Albarracín, 2020) that documented belief that: 1) The CDC exaggerated the danger posed by the virus to hurt President Trump (19% saying probably or definitely true); 2) the US government created the virus (10%); and 3) the Chinese government created the virus (23%). Like ours, that research found that these beliefs were associated with the use of social media (e.g., Facebook) and conservative media (e.g., Fox News, Rush Limbaugh, and Breitbart). While that study confirmed that discernible proportions of the public reported belief in two of these three, it did not assess whether such beliefs are related to the public's willingness to engage in protective action for the pandemic (Jamieson and Albarracín, 2020). Although other work has suggested that COVID-19 conspiracy beliefs hindered the adoption of some preventive behaviors (Barua et al., 2020; Imhoff and Lamberty, 2020), their reliance on small cross-sectional convenience samples limits their interpretation and generalizability.

Examining conspiracy beliefs within the same sample after a four-month interval makes it possible to determine: the stability of such beliefs; whether those assessed in Wave 1 were negatively associated with preventive behaviors including intention to vaccinate; and whether the beliefs were predictive of subsequent recommended action to prevent the spread of the infection, namely mask-wearing (Howard et al., 2020), as well as to intentions to vaccinate when a vaccine becomes available. Based on research indicating the difficulty of correcting conspiratorial beliefs (Jolley and Douglas, 2017; Uscinski et al., 2016), we expected that conspiracy beliefs early in the pandemic would not only remain stable but also would predict subsequent preventive actions and vaccination intentions.

Theories of health behavior suggest that threats to the individual and the community can motivate action (Rogers, 1983; Strecher and Rosenstock, 1997). Still, conspiracy beliefs tend to downplay the threat or suggest other means of confronting it. Thus, we hypothesized that conspiracy beliefs would be inversely related to the perceived threat of the pandemic and that any inverse relation with taking action or accepting a vaccine would be mediated by reduced perceptions of threat.

Previous research has linked conspiracy beliefs with vaccination hesitancy (Hornsey et al., 2020; Jolley and Douglas, 2014). There are at least two paths that could account for that link. One is through reduced perception of the threat and the other through concerns about the safety

of vaccines (Jolley and Douglas, 2017). The latter path would add to the challenge of encouraging adoption of this important prevention strategy. Thus, we also assessed a common misperception about the safety of vaccines, and in particular the measles, mumps, and rubella (MMR) vaccine for children (Kata, 2010). We hypothesized that belief in COVID conspiracies would be positively related to perceptions of the harm of the MMR vaccine and would partially mediate any inverse relationship with intention to vaccinate.

Because taking preventive action appeared to have polarized on partisan grounds, we assessed respondents' political ideology on the assumption that it could be related to both conspiracy beliefs and taking action apart from those beliefs. Building on earlier work (Jamieson and Albarracín, 2020; Motta et al., 2020; Romano, 2020), we also examined whether some patterns of media use were associated with acceptance of COVID-related conspiracies. Consistent with prior research, we expected that reliance on mainstream television news such as NBC news and the national print media such as the New York Times would correlate with higher levels of concern about the pandemic and behaviors to prevent its spread. At the same time, use of conservative media such as FOX News or social media was expected to co-vary with holding conspiracy beliefs (Jamieson and Albarracín, 2020; Motta et al., 2020; Romano, 2020). Because misinformed beliefs are resistant to correction (Chan et al., 2017), beliefs in March would be expected to predict changes in preventive intentions and behavior in July.

To address these questions, we employed a path model that encompassed the relationship between conspiracy beliefs and reported preventive behaviors and willingness to vaccinate against COVID-19. As Figs. 1 and 2 show, the model tested the hypothesis that conspiracy beliefs were inversely related to both, not only directly but indirectly by way of perceptions of the seriousness of the pandemic to the country and the respondents themselves. In the case of vaccination (Fig. 2), we included perceived harms of the MMR vaccine as an additional mediator of the relationship between conspiracy beliefs and intentions to accept vaccination. Finally, we tested whether conspiracy beliefs predict change in either action taken or vaccination intention over the four months between the two survey waves.

In drawing conclusions about the potential causal role of conspiracy beliefs, it was important to control for the demographic profile of respondents who might be susceptible to conspiracy beliefs. Based on research showing that people of lower socioeconomic status are more likely to hold conspiracy beliefs (Douglas et al., 2019; Uscinski and Parent, 2014), it is possible that persons with less education, income, and from traditionally disadvantaged communities, such as racial and ethnic minorities, would be more accepting of COVID-related conspiracy beliefs. The model examined these as predictors of conspiracy beliefs along with other demographic differences and controlled for them as potential third-variable explanations of relations between conspiracy beliefs and our outcomes.

2. Method

2.1. Survey sample

A national probability-based survey of the US population with 1050 respondents was conducted between March 17 and 27, 2020 (Wave 1). The sample was recruited by Qualtrics from the NORC AmeriSpeak Panel (National Opinion Research Center, 2020). To represent the US population, panel selection was determined in part by the likelihood to respond across 48 demographic strata. Wave 2 was collected between July 10 and 21 by inviting the same panel members to take the second survey. We were able to retain 840 (80%) participants in Wave 2. As seen in Table 1, the demographic profile in Wave 2 was virtually identical to Wave 1. Additionally, those who dropped out did not differ from those who remained in any of our dependent variables in Wave 1, except for a small relation between missingness and intention to vaccinate, $r = -0.08$. As a result, we confined our analyses to those who participated in both waves.
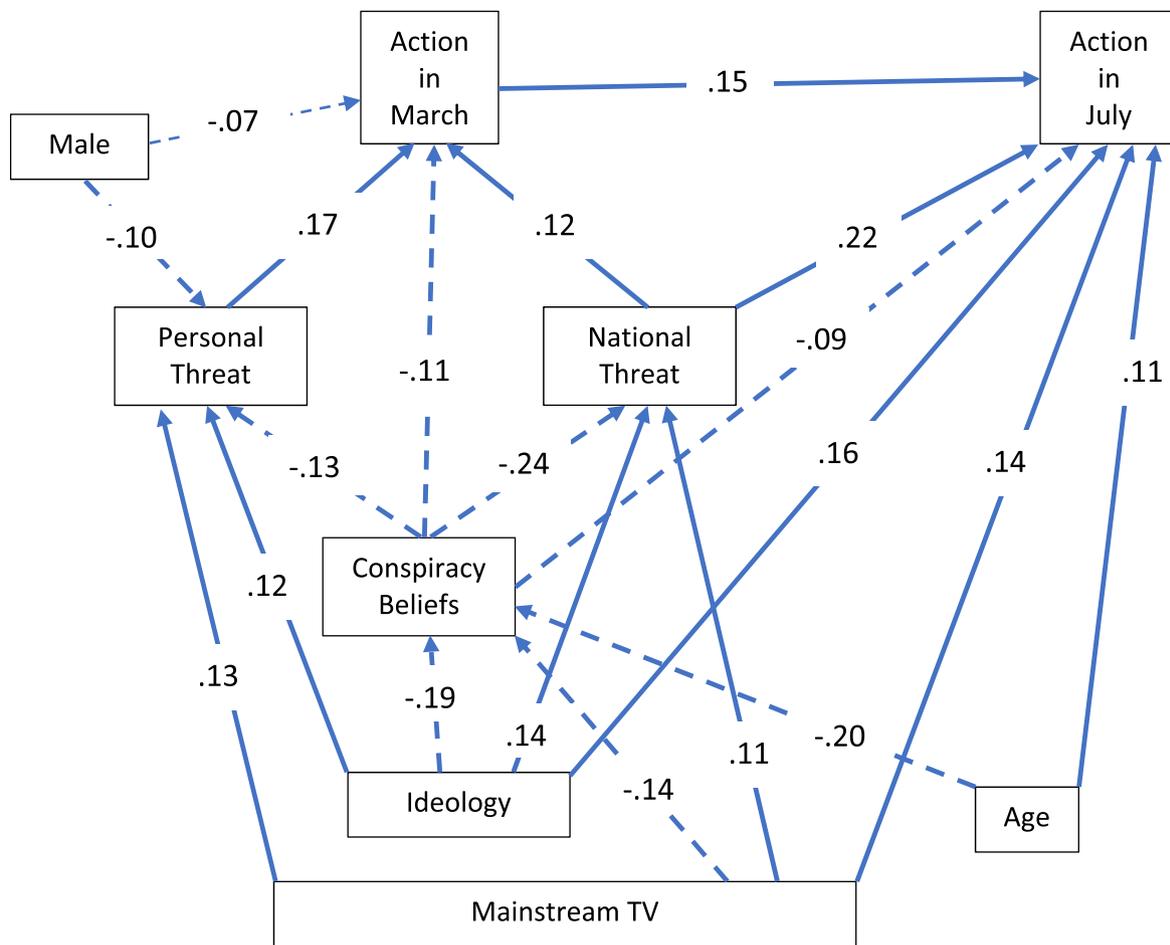
Fig. 1. Path model showing standardized relations between predictors in March and outcomes at both time points for taking action. Darker paths have confidence intervals of $p \pm .005$, while lighter ones are at $p \pm .025$. Dashed paths are indicate inverse relations.

NORC also provided demographic sample weights to enable projections to national responses according to age, gender, race-ethnicity, education, and Census Division based on the Current Population Survey of February 2020. We used those weights in descriptive summaries of the sample (see Tables 1 and 3). All multivariate analyses were conducted with unweighted data and demographic differences controlled.

2.2. Survey content

In both waves, we asked whether the respondent had recently taken any of 9 steps "to protect yourself from getting the coronavirus (COVID-19)." The sum of the number reported was used as an index of taking action to prevent the further spread of COVID-19. As seen in Table 2, only 1.3% failed to take any action. The most frequent action was "washed hands or used a hand sanitizer" (92.5%). Although we included wearing a mask as an option, CDC did not recommend this option until April 3, after evidence of asymptomatic transmission for COVID-19 emerged (CDC, 2020a) and after we completed the first survey. Also, testing for the virus was largely unavailable during the period of the survey. Therefore, we did not include either testing or mask-wearing in our analysis at time one.

Because various states implemented lockdowns on different dates during Wave 1, we examined the relation between date of the interview and our index of taking action. We found no relationship between the two.

In Wave 2, we also asked whether facial masks had been worn in the past few days "when you go to public places where you might encounter other people", with "never, some days, and every day" as the response

options. For this outcome, 79% claimed to wear a mask every day. Because we did not have a useful measure of this behavior in Wave 1, we used the measure of the number of actions taken as a proxy for the willingness to adopt a new preventive behavior. Consistent with this expectation, the number of actions taken was correlated with mask-wearing in Wave 2 ($r = 0.23$), indicating that it could serve this purpose.

We asked respondents "If there were a vaccine that protected you from getting the coronavirus, how likely, if at all, would you be to decide to be vaccinated?" Responses were recorded on a 4-point scale from "Not at all likely" to "Very likely". At Wave 1, only 59.6% said they were very likely to be vaccinated; while 14.5% said they were either not at all or not too likely to be vaccinated. The corresponding proportion who claimed they were unlikely to be vaccinated increased to 25.8% at Wave 2, a trend in line with other national surveys (Elflein, 2020; Romano, 2020). Nevertheless, vaccination intentions were positively correlated over time, $r = 0.63$.

Perceived threat to the country was measured by asking whether the pandemic was a more serious threat to the country than (a) illegal immigration, (b) hurricanes and other natural disasters, or (c) terrorism, with responses recorded on an agree (1) to disagree scale (6). Since responses to these items correlated ($\alpha = 0.84$), we created a national threat index based on the mean responses to them.

Perceived threat to the individual was measured with an item that assessed worry that the virus would infect the respondent or someone in the respondent's family: "How worried, if at all, do you feel about the possibility that you or someone in your family will become infected with the coronavirus?". Responses ranged from "Not at all worried" to "Very worried" on a 4-point scale. This item was highly correlated with the
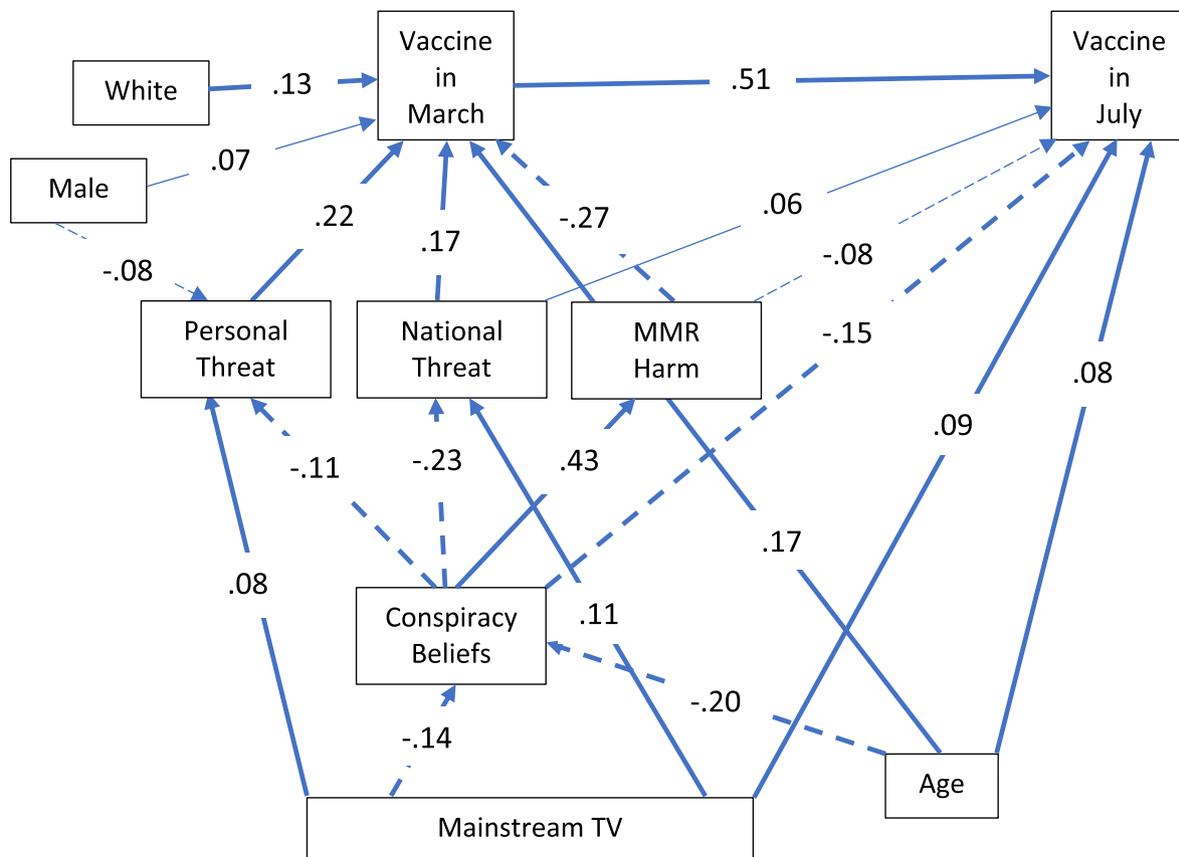
Fig. 2. Path model showing standardized relations between predictors in March and vaccine intentions at both time points. Darker paths have confidence intervals of $p \pm .005$, while lighter ones are at $p \pm .025$. Dashed paths represent inverse relations.

respondents' perceived susceptibility to the infection ($r = 0.48$) and severity of the illness ($r = 0.30$), factors that are related to taking preventative action according to health protection theories (Rogers, 1983; Strecher and Rosenstock, 1997). The percentage who claimed to be very worried declined slightly from Wave 1 to 2 (24.8–21.1, respectively) and remained stable at the individual level, $r = 0.50$.

We assessed belief in three conspiracy theories that either minimized its importance or blamed it on actors presumed to have malicious intent: (a) "The pharmaceutical industry created the coronavirus to increase sales of its drugs and vaccines; " (b) "The coronavirus was created by the Chinese government as a biological weapon; " or (c) "Some in the U.S. Centers for Disease Control and Prevention, also known as CDC, are exaggerating the danger posed by the coronavirus to damage the Trump presidency." Belief in these statements was registered from "Definitely false" to "Definitely true" on a 4-point scale. Since beliefs in these conspiracies were inter-related, we created an index based on the mean of the items ($\alpha = 0.72$). The mean (*SD*) of the index increased slightly from Wave 1 to 2 (1.75 (0.85) vs. 1.90 (1.08), respectively) and the beliefs were positively correlated over time, $r = 0.75$.

We queried belief in the harms of vaccines with the following item: "How likely do you think it is that vaccines given to children for diseases like measles, mumps, and rubella can cause neurological disorders like autism?" Responses were recorded on a 4-point scale ranging from "Not very likely" to "Very likely." Consistent with the hypothesis that conspiracy beliefs regarding the COVID-19 crisis will also underlie a wide range of health issues, the belief that vaccines are harmful was also correlated with the conspiracy index, $r = 0.48$.

We assessed political ideology by asking: "Generally speaking, would you describe your political views as:" with response options on a 5-point scale from "very liberal" to "very conservative". Media use was assessed to cover the political spectrum, from liberal outlets (e.g., MSNBC and the

Huffington Post), mainstream TV (e.g., ABC, CNN) and mainstream print (NY Times, Washington Post, and Wall Street Journal), to conservative media (e.g., Fox News and Rush Limbaugh). Also, we assessed use of news aggregators (e.g., Google News) and social media (e.g., Facebook). For each type of media, respondents rated how much information they got "from such sources as…" on a 5-point scale from "No information" (0) to "A lot of information" (5). (See Appendix for the wording of these news items.)

2.3. Analytic strategy

We used the structural equation program Mplus (Muthen and Muthen, 1998-2017) to model the predicted paths between conspiracy beliefs and both preventive actions taken and vaccination intention. This strategy allowed us to test mediation and to separate relations between conspiracy beliefs and outcomes that were stable over time versus those that emerged following Wave 1. A power analysis using a Monte Carlo procedure in Mplus (Muthen and Muthen, 2002) determined that a sample size of 800 would provide sufficient power to detect a mediated standardized relation of 0.04 or larger with a 95% confidence interval (CI). Therefore, we anticipated that a sample size of 1050 would give us enough power if we achieved the expected 75% participation in Wave 2.

We restricted the analysis to the 840 respondents who participated in both waves. Approximately 2.6% of the cases had missing data for one or more items, and these cases were also omitted in the Mplus models. Standard goodness of fit measures were used to assess model fit (Bollen and Davis, 2009). We used bootstrapping procedures (with samples of 1000) provided by Mplus to estimate confidence intervals for all predictors in the models. Other analyses were conducted using SPSS version 26.

Table 1
Demographic characteristics of both waves.

Characteristic	Raw N Wave 1 (N = 1050)	Weighted % of Sample Wave 1	Raw N Wave 2 (N = 840)	Weighted % of Sample Wave 2	p for Difference in Raw Ns
Gender					
Male	486	45.6	401	44.3	.54
Female	558	54.4	435	55.4	
Age					
18–29	131	20.7	104	20.5	.97
30–44	313	24.1	245	23.9	
45–59	249	25.2	197	24.9	
60+	357	30.0	294	30.7	
Race/Ethnicity					
White	807	73.0	655	74.2	.66
Black	121	13.9	96	12.8	
Hispanic	136	14.8	97	15.2	
Education					
High school or less	216	32.6	168	32.6	.78
Some College	625	47.8	514	48.3	
Post-Graduate	206	19.6	157	30.1	
Income					
<$30K	244	26.4	198	26.8	.84
$30 to $85	460	41.9	357	40.9	
$85 to >$200K	346	31.7	285	32.3	
Political ideology					
Conservative	289	29.6	238	29.6	.85
Neither	435	41.4	340	40.3	
Liberal	304	28.9	251	30.1	
News Source					
Mainstream TV					
None	141	14.0	110	13.4	.98
Some	472	43.1	378	44.1	
A lot	423	41.7	340	42.5	
Mainstream print					
None	321	32.8	254	34.0	.98
Some	471	44.9	380	44.8	
A lot	242	20.8	194	21.2	
Social					
None	338	31.5	279	32.6	.80
Some	502	47.7	404	47.8	
A lot	199	19.7	150	19.6	
Aggregators					
None	267	25.1	210	25.2	.97
Some	557	54.0	447	53.7	
A lot	217	19.9	176	21.1	
Conservative					
None	535	48.9	437	50.6	.92
Some	334	31.4	262	31.1	
A lot	166	18.0	131	18.3	
Liberal					
None	447	42.9	351	43.2	.92
Some	457	44.6	372	45.7	
A lot	132	11.1	108	11.1	

Note. Differences in raw distributions were determined using χ^2-Square tests.

3. Results

Table 3 displays the demographic and media reliance of the sample and proportions of the weighted sample that reported that each of the three conspiracy theories was either definitely or probably true. High proportions reported belief in the conspiracies, ranging from a low of 14.8% for the pharmaceutical industry having created the virus to a high of 28.3% believing that the Chinese government created the virus as a bioweapon. Different patterns of media were associated with belief in the theories. In particular, heavy users of conservative and social media tended to assign greater credibility to those beliefs. Finally, various demographic characteristics (age, education, income, and racial-ethnic identity) were related to conspiracy beliefs.

The path model (Fig. 1) found that action taken in March was related

Table 2
Actions taken to protect from getting or spreading infection in March 2020 (N = 840).

Action	% Reporting	Number of Actions Taken	% of all Actions Taken
Washed hands or used a sanitizer	92.9	0	1.3
Kept distance from others	84.4	1	3.7
Avoided gatherings >10 people	82.4	2	3.2
Stayed at home	80.5	3	3.8
Covered nose & mouth when coughing	74.4	4	9.8
Avoided contact with sick people	69.8	5	16.0
Avoided touching face	67.2	6	23.5
Wore a face mask	10.2	7	38.8
Got tested for the virus	0.7		
Did nothing	1.3		

Note. Number of actions taken is the sum across all 7 included in the index and the percentage is the distribution of those sums.

Table 3
Percentages of sample believing in conspiracy beliefs by demographic characteristics and news use in March 2020 (N = 840).

Characteristic	% of Sample	Pharma	CDC	Chinese
Gender				
Male	44.1	9.6	**27.0**	29.1
Female	55.6	19.1	**20.3**	27.8
Age				
18–29	20.7	**26.9**	22.7	**35.1**
30–44	23.8	**21.9**	30.1	**29.8**
45–59	24.5	**10.9**	25.1	**30.3**
60+	31.0	**4.3**	17.1	**22.3**
Race/Ethnicity				
White	74.7	**9.7**	**22.3**	25.5
Black	13.9	**36.3**	**31.4**	43.8
Hispanic	15.4	**29.1**	**28.6**	33.8
Education				
High school or less	32.9	**27.0**	**31.8**	42.7
Some College	48.2	**12.1**	**21.7**	24.0
Post-Graduate	19.0	**6.9**	**12.1**	12.7
Income				
<$30K	26.4	**27.4**	27.2	**37.0**
$30 to $85	41.1	**13.7**	21.5	**28.5**
$85 to >$200K	32.4	**5.6**	22.5	**21.4**
Political ideology				
Conservative	29.8	**11.1**	**40.2**	37.1
Neither	40.0	**16.4**	**22.6**	30.6
Liberal	30.2	**16.2**	**8.0**	17.4
News Source				
Mainstream TV	41.9	13.3	**15.1**	24.7
Conservative	18.1	13.4	**33.5**	51.6
Liberal	11.1	19.6	**11.0**	21.8
Aggregators	20.9	**24.2**	**25.0**	32.2
Social	19.6	**19.8**	28.6	**41.8**
Mainstream print	21.0	**15.0**	**13.2**	**18.4**
Total	100	14.8	23.5	28.3

Note. Pharma = Pharmaceutical industry responsible; CDC = Damages Trump; Chinese = Created virus. Bolded proportions are for response distributions that are significantly different (*p* < .05) either across demographic groups or within each media use.

to conspiracy beliefs both directly and indirectly through perceived threat to the individual and the nation. The relation between personal threat and action remained despite the confounding relation with male identity, which was also negatively related to both. Importantly, conspiracy beliefs in March predicted action (mask-wearing) in July both directly [-0.08, 99% *CI* (−0.195, −0.002)] and indirectly through perceived national threat [-0.24 × 0.22 = −0.05, 99% *CI* (−0.091, −0.025)]. Conspiracy beliefs also predicted subsequent mask-wearing through its relationship with action in March, resulting in a total

relation of −.16, 99% *CI* (−0.26, −0.07). Thus, the relationship between conspiracy beliefs and action taken in July was more than 5 times greater than what was attributable to those beliefs in March, going from −0.03 to −0.16. Mask wearing was also predicted by increasing age, use of mainstream TV, and liberal political ideology, each of which was also related to components of the model for preventive action in March. Notably, mainstream TV was negatively related to conspiracy beliefs and positively to both types of threat.

There also were relations between other kinds of media sources and components of the model in March (see Table 4). Conservative and social media use were positively related to belief in conspiracy theories, whereas mainstream print was inversely related to conspiracy beliefs as were education, income, and White racial identity. Also, mainstream print and the aggregators were positively related to personal threat. All of the media relations remained after controlling for demographic differences, and particularly political ideology, which was strongly correlated with the use of conservative media ($r = -0.42$) and somewhat less with liberal media ($r = 0.30$) and mainstream print ($r = 0.33$). This confound was less likely for social media ($r = 0.06$), use of aggregators ($r = 0.12$), and mainstream TV ($r = 0.17$).

In the case of vaccination (Fig. 2), perceived threat to the respondent and the nation remained as mediators of the relation between conspiracy beliefs and vaccine intention in March. However, the belief that the MMR vaccine is harmful was a strong mediator of the relation between conspiracy beliefs and vaccine intention and resulted in a somewhat stronger total relation between conspiracy beliefs and vaccination intention than for actions taken (−0.19 vs. −0.16 in standardized units). Change in vaccine intention in July was predicted by conspiracy beliefs both directly, −0.15, 99% *CI* (−0.25, −0.06), and indirectly as mediated by MMR harm, −0.033, 95% *CI* (−0.072, −0.003). The total effect of conspiracy beliefs on vaccine intentions in July including carry-over from March was substantial, −0.29, 99% *CI* (−0.37, −0.22). Thus, the relationship between conspiracy beliefs and vaccination intention in July more than doubled from its carryover in March (−.11 to −0.29). Reliance on mainstream TV was a positive predictor of vaccination in July. There was also a positive relation between reliance on social media and perceptions of MMR harm (Table 4), while education and White identity were negatively related to harm.

The ability of conspiracy beliefs to predict change in each outcome was robust to controls for demographic differences and news use. In each case, the prediction remained despite controls for variables that were related to both outcomes and conspiracy beliefs (e.g., age, mainstream TV, and ideology). Both models provided good fits to data, with small values of RMSEA (0.033 and 0.044) and high values of CFI (0.97, 0.96) and TLI (0.94, 0.92). We also tested actions taken by treating it as a count variable, but again the results remained very much the same.

Table 4
Standardized predictors of conspiracy beliefs, pandemic threats, and vaccine harm in March 2020.

News Source & Demographic Predictors	Conspiracy Beliefs	National Threat	Personal Threat	Vaccine Harm
Liberal	–	.13	–	–
Conservative	.22	-.10	–	–
Aggregators	–	–	.07	.09*
Social	.08	–	–	.07*
Mainstream Print	-.14	–	.09	–
Education	-.17	–	–	-.09
Income	-.06*	–	–	–
White Racial Identity	-.13	–	–	-.08*
Liberal Ideology	-.19	.14	.11	–

Note. Vaccine harm was tested in a separate model from action taken. All coefficients have confidence intervals of $p \pm .005$ except for those at $p \pm .025$ marked by *.

4. Discussion

Our results show that early in the pandemic in the US, COVID-related conspiracy beliefs were inversely related to both reporting taking preventive actions and intentions to vaccinate against the disease. Individuals younger in age and lower in income and education were more likely to hold conspiracy beliefs about the origins and seriousness of the pandemic. Non-white respondents also were more likely to hold such beliefs. Since the likelihood of dying of COVID-19 increases with age (CDC, 2020b), the age finding is heartening. Since people of color are disproportionately dying of it (CDC, 2020c), the finding that they are more likely to hold conspiracy beliefs is worrisome.

All of these relations are consistent with the suggestion that persons who feel politically powerless are more susceptible to conspiracy theorizing (Crocker et al., 1999; Uscinski and Parent, 2014; Uscinski et al., 2016). They also are more likely to accept statements from sources that question the legitimacy of the political system (Hahl et al., 2018; Harambam and Aupers, 2015). These conspiratorial beliefs tend to attribute power to unseen actors who have interests that diverge from those of the average person. Although some have characterized conspiracy beliefs as aberrant (see review by Douglas et al., 2019) or reflective of paranoid thinking styles (Hofstadter, 2008), our findings suggest that they also are common enough to be problematic.

Our results also show that conspiracy beliefs early in the pandemic continued to be related to subsequent behavior and intentions four months later. Mask wearing is increasingly seen as critical to controlling the spread of the coronavirus (Howard et al., 2020), and those holding conspiracy beliefs were less likely to engage in it even after health officials recommended it. Additionally, vaccination hesitancy increased since Wave 1, a finding that matches trends in other national surveys (Elflein, 2020; Romano, 2020). Here again, we found that the increase in hesitancy was predicted by earlier endorsement of conspiracy beliefs. These findings suggest that conspiracy beliefs play a causal role in reducing the embrace of public health recommendations to control the pandemic.

The results also suggest that perceptions of the seriousness of the pandemic mediated the relation between conspiracy beliefs and mask-wearing, while perceptions of personal threat were only directly related to each outcome in Wave 1. It is also noteworthy that reliance on mainstream TV news was a positive predictor of change in both outcomes, as well as negatively related to conspiracy beliefs and positively to both types of threat in March. These patterns suggest that mainstream TV news plays a larger role than other news media in emphasizing the importance of the pandemic's threat and in not legitimizing COVID-related conspiracy theories.

In distinction to the role played by mainstream TV news, reliance on conservative media was positively related to endorsing conspiracies and negatively related to perceptions of the national threat. This finding comports with the inverse relation we observed between liberal political ideology and COVID-related conspiracy beliefs. Use of liberal media was also positively related to seeing the pandemic as a national threat, consistent with national polls showing partisan differences in support for actions to prevent the spread of the infection (Allcott et al., 2020; Pew Research Center, 2020). It is perhaps fortunate that partisan differences were less related to vaccination intentions than to taking action at either point. Neither political ideology nor conservative media reliance was directly related to perceptions of MMR harm or vaccine intentions. Nevertheless, these patterns suggest that the partisan cueing that has been apparent in the government and conservative media may be affecting the public's response to the pandemic, as they have in previous health threats (Singer et al., 2020).

The proportions who agree that the novel coronavirus was created by the Chinese government as a bioweapon or that some in the CDC are exaggerating the seriousness of the virus to undermine the Trump presidency are higher in this study than those reported by Jamieson and Albarracín (23% vs. 28% for China and 19% vs. 23% for CDC). A likely

reason is that, unlike ours, their respondents were given the option of saying they were "not sure" of the answer. Since it is unlikely that belief changed dramatically in the few weeks between their early March and our late March survey, the difference in response options probably explains the increased acceptance of the same conspiracy beliefs that we found. The higher proportions that reported acceptance here suggest that those who are unsure are more inclined to believe than not. Our proportions are also in line with those observed by Uscinski et al. (2020) who also did not allow a not-sure response, and the findings of Oliver and Wood (2014) who surveyed other conspiracy theories related to health outcomes. Nevertheless, identifying those who are unsure may be important because persuasion is more likely among those who have not yet made a firm commitment to a belief.

The negative relation between conspiracy beliefs and taking preventive actions required to control the spread of COVID-19 poses challenges for public health. Persons holding conspiracy beliefs are likely to resist actions recommended by public health agents, such as the CDC (Nyhan and Reifler, 2015). They also are likely to turn down an eventual vaccine. The challenge for public health officials is compounded by the finding that anti-vaccine social media networks are highly interconnected and likely to influence others more so than are pro-vaccination networks, which are more peripheral and less connected with other networks (Johnson et al., 2020). Our findings regarding social media as a source of information related to conspiracy beliefs add to this concern.

Although personal perceptions of threat mediated taking preventive action for both outcomes, conspiracy beliefs were more closely related to vaccination hesitancy through perceived MMR harms. Displacing worry about the harms of vaccination should be a goal of those encouraging the uptake of an eventual vaccine for the coronavirus.

Prior research suggests that efforts to reduce conspiracy beliefs with information face significant obstacles, a phenomenon that may be related to their non-falsifiability (Lewandowsky et al., 2012; Uscinski, 2017) and believers' underlying distrust of elites who provide corrective information. Another reason for the robustness of conspiracy theories is the tolerance that those who hold them have for inconsistency (Douglas et al., 2019; Miller, 2020; Wood et al., 2012). For example, believing that the Chinese government created the virus is inconsistent with believing that the pharmaceutical industry was the originator. This pattern suggests that the relation between these beliefs is more of an "or" than an "and" one so that disputing one does not affect any other (Miller, 2020). What underlies beliefs in the conspiracy theory space is an underlying distrust of those in power (Crocker et al., 1999; Uscinski and Parent, 2014; Uscinski et al., 2016).

Our analyses of media sources, as well as those of others (Motta et al., 2020; Romano, 2020), suggest that conservative outlets which tend to support the President and social media that do not control the content on their sites (Gregory and McDonald, 2020) have been purveyors of conspiracy theories. Although Facebook, Twitter, and Instagram all began blocking COVID misinformation before our first survey (see Jamieson and Albarracín, 2020), we saw a slight increase in the level of conspiracy belief within our panelists between March and July.

This study also exposes the cost of failing to interdict misinformed beliefs at their outset. Had the misbelief that the MMR vaccine can cause autism been dispatched when it emerged in 1998 (Eggertson, 2010), it would not be affecting the willingness to take the COVID-19 vaccine now. For this reason and because belief in the three conspiracy theories on which we focused here predicts resistance to both preventive behaviors and COVID-19 vaccination, it will be critical for the public health community to increase its messaging in mainstream media and, in particular, in conservative media outlets. State-of-the-science methods should be deployed to debunk or displace the conspiracy theories and vaccine fears identified here (see Lewandowsky et al., 2012).

4.1. Limitations

Our study has limitations. New conspiracies have emerged since we began this study; but as observed by Miller (2020), even those are highly related to the ones we assessed. At the same time, greater direct experience with the effects of the disease on friends and family may have made the threat of the pandemic to the country more real, something we did not reassess in July. Our measures of media use may be difficult to separate from personality differences, but we controlled for political ideology in all our analyses and the most robust predictor of change in outcomes, mainstream TV use, was not highly related to ideology. Our sample of 840 respondents may limit our ability to generalize to the entire US population. However, many of the patterns we observed in regard to conspiracy beliefs, media use, political ideology and vaccine acceptance were consistent with other national polls. Finally, our use of an online panel may also have reduced the representativeness of the sample, but our findings regarding the prevalence of conspiracy beliefs and their relation with media use were consistent with an earlier survey that was conducted by telephone (Jamieson and Albarracín, 2020).

5. Conclusions

Conspiracy beliefs regarding the coronavirus pandemic in the US were widespread and persistent over four months, more likely to be held by either persons with conservative political ideology or in disadvantaged racial-ethnic groups and more likely to be associated with use of conservative media outlets. Additionally, persons with non-White racial-ethnic identity and those using social media were more likely to believe that the MMR vaccine is harmful. Conspiracy beliefs and their associations with perceptions of vaccine harm present continuing challenges to the control of the coronavirus pandemic because of their persistence and association with non-acceptance of recommended action, especially mask-wearing, and increasing unwillingness to receive a vaccine when it becomes available. Confronting these conspiracy beliefs will require action by journalists and commentators, especially those with politically conservative audiences, to increase acceptance of medically recommended actions to control the pandemic.

Credit author statement

Both authors contributed equally to the conceptualization and writing of the paper. DR conducted the analyses.

Appendix

Media Battery (Rated on a 5-point scale ranging from No information to A lot of information)

How much information do you get from sources such as Fox News, Rush Limbaugh, Breitbart News, One America News or The Drudge Report?

How much information do you get from sources such as MSNBC, Bill Maher or the Huffington Post?

How much information do you get from sources such as ABC News, CBS News or NBC News?

How much information do you get from sources such as Google News or Yahoo News?

How much information do you get from sources such as Facebook, Twitter or YouTube?

How much information do you get from sources such as the Associated Press, The New York Times, the Washington Post, or the Wall Street Journal?

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