Do Attitudes, Trust, and Acceptance of Pseudoscience and
Conspiracy Theories Predict COVID-19 Vaccination Status?

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Abstract

Vaccine hesitancy among the general population has become a primary concern for contending with the COVID pandemic as policymakers continue to exhaust options to incentivize individuals and vaccination uptake begins stagnating. The current study explores the relative contributions of several potential predictors of vaccine hesitancy. In an online cross-sectional survey study, 917 individuals from the U.S. were assessed on general and COVID-specific vaccine attitudes, COVID conspiracy and pseudoscientific beliefs, trust in various sources of information about COVID, and health and safety concerns surrounding the COVID vaccination. COVID vaccine attitudes, as well as general vaccine attitudes and behaviors, explained a substantial amount of variance, with trust in various information sources being moderately predictive of COVID vaccine attitudes. The data indicated a weak relationship between conspiracy and pseudoscientific beliefs, which disappeared altogether upon controlling for other variables. These findings suggest that efforts to confront vaccine hesitancy should go beyond confronting misinformation and consider initiatives aimed at trust enhancement and attitude change in vaccine-hesitant individuals.

Keywords: COVID-19, vaccine hesitancy, immunization, vaccine attitudes, trust, conspiracy beliefs, pseudoscience

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Government and public health officials continue to try to increase the percentage of those who have been vaccinated from COVID. Although at first there was an immediate uptake in vaccination rates, those rates have stalled (USAFacts, 2021). As of August 2021, The Mayo Clinic COVID vaccination tracker showed that just over half of the US population was fully vaccinated (and around 60% partially vaccinated), with percentages varying across different states and regions (Mayo Clinic, 2021). It would be easy to draw sweeping generalizations about the reasons for the relatively low rate of vaccine uptake (e.g., anti-vaxxers, anti-science), but such explanations are likely oversimplified and inaccurate. Though it is likely true that some of those who have not received the COVID vaccine are also devout antivaxxers – as would be expected for any vaccine – it is unlikely that such an explanation applies to the entire 40% of the population who have chosen to, so far, remain unvaccinated. The relatively lower rate of COVID vaccination (compared to 80-90% vaccination rates in other common vaccines; Centers for Disease Control, 2021) suggests that anti-vax and anti-science explanations may leave out a substantial portion of individuals who are unvaccinated or partially vaccinated.

While not altogether discounting the possibility that all 40% of those who remain unvaccinated may be devout antivaxxers, the current study explored the potential that several additional factors help to differentiate those who have elected to receive one of the COVID vaccines from those who have not. Specifically, we explored the potential that vaccine-related attitudes (i.e., general stance toward vaccination, flu vaccination frequency, attitudes about the COVID vaccines), trust in different sources of information as it pertains to COVID (e.g., the media, government), and endorsement of misinformation (i.e., COVID conspiracy beliefs,

pseudoscientific beliefs) may contribute to the decision to receive the COVID vaccine and the likelihood of those who are unvaccinated planning to get the vaccine in the future.

Attitudes and Decision Making

It has been well-established that people's attitudes influence their behavior, although the strength of this relationship is affected by factors such as attitude strength, stability, accessibility, and level of specificity (Glasman & Albarracin, 2006; Kraus, 1995). The stronger, more accessible, stable, and specific the attitude, the more likely that attitude is to lead to behaviors that are consistent with that attitude. We would, therefore, expect that when it comes to COVID vaccination, a similar trend would emerge, which has been observed in previous studies specific to the COVID vaccine (e.g., Juanchich et al., 2021, Wolff, 2021). That is, the conclusion that some individuals have pre-existing anti-vaccine attitudes that result in a bias against receiving the COVID vaccine is well-founded and one we expected to reproduce in the current study.

Yet, prior studies looking at vaccine attitudes and intentions to receive the COVID vaccine indicate that attitudes toward vaccines explain only a moderate amount of the variance in people's likelihood of being (or planning to become) vaccinated (Taylor et al., 2020), though bivariate correlations often range from .50 to as high as .80. Other studies have shown that people's attitudes toward the COVID vaccine and their plans to be vaccinated are also influenced by the frequency with which they received their annual flu vaccine (El-Elmat et al., 2021). While there is likely some overlap between general vaccine attitudes and the frequency with which people receive their annual flu vaccine, the propensity to follow through on vaccination behaviors, as in receiving flu vaccinations in the recent past, explains variance not explained by general vaccine attitudes (El-Elmat et al., 2021), a trend also demonstrated regarding intentions to receive flu vaccines among healthcare workers (Arghittu et al., 2020).

An additional idiosyncrasy with the COVID vaccines was that in the US those vaccines were approved for emergency use (though full approval was recently granted for the Pfizer vaccine), which appeared to affect many people's attitudes toward the vaccine, along with questions about the vaccine's efficacy and possible side effects (Kreps et al., 2021). As such, though many people may have a general positive view toward vaccines in general and may regularly obtain their flu shots, general vaccine attitudes and behaviors alone may be insufficient to explain people's decision regarding whether to receive the COVID vaccine. Any attempt to predict such a decision must also account for the possibility that people's attitudes toward the COVID vaccines specifically would play a role in that decision.

Based on prior research concerning the role of general vaccine attitudes, the role of recent flu shot behavior in predicting COVID vaccine intentions, and the potential for COVID vaccine-specific attitudes to relate to vaccination decisions, we predicted the following:

H1: Those who report being more supportive of vaccination in general (H1a), regularly getting the flu shot (H1b), and possessing more positive attitudes toward the COVID vaccines (H1c) will be more likely to report being vaccinated.

We also posed the following research question (RQ):

RQ1: What aspects of the COVID vaccine safety and effectiveness are most strongly associated with vaccination?

Trust in Information & Decision Making

The COVID-19 pandemic has resulted in the production of a large quantity of information through various channels (e.g., news stories, social media, research publications, practitioner articles). There is some existing evidence that, when it comes to disease and vaccination, vaccine hesitant individuals (those who possess vaccine-related concerns that cause

them to forego vaccination currently, regardless of whether they eventually choose to vaccinate) often tend to be less trusting of information put forth by various entities (e.g., doctors, experts; Yaqub et al., 2014). As it concerns COVID-19 specifically, there is also evidence that people vary in the amount of trust they place in information received from various sources (e.g., media, scientists, healthcare professionals; El-Elimat et al., 2021; Fridman et al., 2021; Murphy et al., 2021; Piltch-Loeb et al., 2021). Prior research has shown that the more trust individuals put into the government, scientists, and healthcare professionals, the less likely they are to be COVID vaccine hesitant. We, therefore, expected to find the same result, proposing:

H2: Those who are more trusting of information related to COVID from various sources will be more likely to report being vaccinated.

There is reason to believe, however, that trust in different information sources may differentially relate to people's decision of whether to vaccinate. Numerous studies have shown that people place differing levels of trust in the government, scientists, the media, and other sources of information (El-Elimat et al., 2021; Fridman et al., 2021; Murphy et al., 2021; Piltch-Loeb et al., 2021), and Jennings et al. (2021) found that trust in government, experts, and health organizations were all significantly related to people's willingness to receive the COVID vaccine. As such in the present study, we expected that:

H3: Trust in scientists (H3a), the government (H3b), and one's doctor (H3c) would be predictive of respondents' vaccination status.

RQ3: Does trust in information explain any variance in vaccination status beyond vaccine attitudes?

H4: Trust in scientists (H4a), the government (H4b), and one's doctor (H4c) would be predictive of respondents' attitudes toward the COVID vaccine.

COVID Conspiracies and Pseudoscience

COVID conspiracy theories have propagated since the onset of the pandemic, ranging from those involving the potential for 5G to cause COVID to the possibility of vaccines possessing secret microchips that would monitor people's behavior to the virus itself being a hoax (Freeman et al., 2020; Garry et al., 2020; Jennings et al., 2021; Roozenbeek et al., 2020; Teovanović et al., 2021). Additionally, Roozenbeek et al. (2020), Jennings et al. (2021), and Teovanović et al. (2021) found that those who accepted various COVID conspiracies theories, even though they represented a small percentage of the overall population, were more likely to be vaccine hesitant.

Although acceptance of COVID conspiracy theories may exist only among a small percentage of the population, conspiracy acceptance alone may not be responsible for vaccine hesitancy (otherwise, we would expect vaccination rates close to 90%). Prior research has shown that people also vary in their beliefs about various pseudoscientific treatments and those beliefs may adversely affect their choices regarding traditional medical advice (Soveri et al. 2020). Teovanović et al. (2021) found that practicing pseudoscience behaviors (e.g., consuming supplements, using essential oils) was associated with decreased willingness to follow COVID safety practices, but they found it was unrelated to people's reports of vaccine hesitancy. Yet, there is little systematic research to assess the role of pseudoscientific beliefs (as opposed to beliefs in bad science) in people's willingness to be vaccinated. Given that acceptance of pseudoscience tends to be correlated with people's willingness to accept conspiracy theories (e.g., Lobato et al., 2014, Teovanović et al., 2021), it seems likely that there would be at least a small association between people's endorsement of pseudoscientific beliefs and the decision to

be vaccinated (though it is likely weaker than people's more specific vaccine-related attitudes).

As a result, we predicted:

H5: Those who are more accepting of COVID conspiracies will be less likely to be vaccinated (H5a), report fewer positive attitudes toward the COVID vaccine (H5b), and report less trust in COVID-related information (H5c).

H6: Those who are more accepting of pseudoscience will be less likely to be vaccinated (H6a), report fewer positive attitudes toward the COVID vaccine (H6b), and report less trust in COVID-related information (H6c).

In addition to the formal hypotheses and research questions, we also conducted some follow-up exploratory analyses regarding people's reported reasons for being unvaccinated and the likelihood those who were unvaccinated planned to get the vaccine in the future.

RQ4: What percentage of those who were unvaccinated planned to get vaccinated in the future?

RQ5: What predominant reasons were provided by those who have chosen to not get one of the COVID vaccines and do those reasons differ based on likelihood of future vaccination?

RQ6: Do any of the primary study variables help to explain the likelihood of future vaccination?

Method

Participants and Procedure

We recruited respondents for the current study using CINT (<https://www.cint.com/>), an online platform that allows researchers to collect survey panel data, with recruitment seeking to obtain a representative sample based on sex, age, and region. Data were collected between June 21 and July 2, 2021. Originally, 1,216 respondents accessed the survey. After deleting those who

completed less than three-quarters of the survey ($n=195$) and those whose response times for the survey were less than two minutes ($n=104$), we were left with a sample of 917 respondents (45.6% male). In terms of age, 29.7% of the sample was between 18 and 30 years old, 35.9% were between 31 and 50, and 34.2% were 51 or older (with 2 missing). In terms of other demographics of relevance, 51.3% reported being married or cohabitating, 44.1% possessed at least a bachelor's degree, and 63.6% worked either fulltime or parttime.

In terms of COVID- and vaccine-specific demographics, 67.3% reported being fully or partially vaccinated against COVID, and 32.7% reported being unvaccinated. Of the vaccinated, 67.3% reported having been so for more than a month. Of the unvaccinated, only 26.7% indicated they definitely or probably would get vaccinated in the future. In terms of risk, 18% of the total sample reported being high risk due to age (with 10.3% missing data about this risk category), and 26.9% reported being high risk due to health (with 10.3% again missing data about this risk category). Only 13.1% of the sample reported having been diagnosed with COVID, though 7.7% preferred not to answer. A majority (57.3%) of the sample reported having a positive stance toward general vaccinations like MMR (i.e., everyone who should be vaccinated should), and 61.9% reported that they always or usually receive their flu vaccine.

Measures

COVID- and Vaccine-Specific Items. The study included a variety of items designed to assess COVID- and vaccine-specific information. The list of items can be found in Appendix A, along with the process we used to recode the items for analytical purposes. These served as several of the primary study variables for analytical purposes.

COVID Vaccine Attitudes. We developed four items to assess people's attitudes toward the COVID vaccines. The list of items can be found in Appendix B, and each item was scored on

a 4-point scale (1=Strongly Disagree; 4=Strongly Agree). The four items demonstrated good internal consistency ($\alpha = .86$).

Trust in Information about COVID. We assessed trust in various information sources starting with items developed by Murphy et al. (2021). However, to ensure the items were specific to COVID, we revised and expanded their initial list (see Appendix C), with items scored on a 4-point scale (1=Strongly Disagree; 4=Strongly Agree). We calculated an overall trust score ($\alpha = .92$) and sub-scores for trust in government (CDC, federal, and state; $\alpha = .82$), news sources (national, local; $\alpha = .84$), and science (scientists conducting research, communicating information; $\alpha = .84$), and trust in one's doctor (single item).

Pseudoscientific Beliefs. We developed a scale for the current study that was based on the one developed by Lobato et al. (2014), which included 15 pseudoscience items (e.g., “Geological objects, such as stones or crystals, can possess intrinsic healing properties” and “Detox diets and/or colon cleansing effectively eliminate toxins that have accumulated in the body”) and seven real science filler items (e.g., “Dolphins are a type of mammal”) scored on a 5-point scale (5=Definitely True; 1=Definitely Untrue). One of the pseudoscience items concerned the belief that vaccines cause autism, and this item was excluded due to significant overlap with other items included in the current study.

COVID Conspiracies. We perused the literature and eventually started with the list of conspiracy items presented by Garry et al. (2020). We revised three items, replacing the word “coronavirus” with “COVID.” One of the items (i.e., “Muslims are spreading the virus as an attack on Western values”) appeared to have been somewhat outdated, so we replaced that item with one adapted from Freeman et al. (2020): “The COVID vaccines contain microchips to control people.” Items were scored using a 6-point scale (1=Strongly Disagree; 6=Strong Agree),

with two of the items being reverse scored. In conducting preliminary analyses, we found that the two reverse scored items did not load properly onto the same factor as the positively-keyed items. Therefore, we treated them as filler items, removing them from subsequent analyses, and the aggregated scores of the remaining items showed strong internal consistency ($\alpha = .92$).

Concerns with Vaccination. We asked those who were currently unvaccinated to respond to a series of items that related to possible concerns they may have with the COVID vaccines (see Appendix D). The list of items was developed based on perusal of social media, various mainstream news sources, and existing studies on the topic. Though we treated the items individually, we also calculated a summed score based on yes responses. Respondents selected an average of 5.40 reasons for their vaccine hesitancy (minimum=0; maximum=13), with a median and modal response both equal to 6.

Demographics. We included a section of the survey to assess demographics, such as sex, age, marital status, and education. The complete list can be found in the supplemental materials at <https://osf.io/rvahu/>.

Results

To decrease the likelihood of making a Type 1 error, we set a more conservative p -value of .01 for all analyses. Descriptive statistics for all primary study variables can be found in Table 1. Not surprisingly, those who reported more regularly getting their flu shots and who had a more positive stance on vaccination were also much more likely to report being vaccinated from COVID ($r=.38$ and $.51$, respectively), the latter of which was also the strongest bivariate correlate of vaccination status. We also observed relatively strong associations among all the trust facets, suggesting that people possessed relatively consistent levels of trust across the

various sources of information. To formally test the hypotheses and follow up on our research questions, we conducted a series of follow-up analyses.

General Vaccine Stance, Flu Shot Frequency, and COVID Vaccine Attitudes

The first analysis tested whether people's general stance toward vaccination (H1a), the behaviors regarding the annual flu shot (H1b), and their attitudes toward the COVID vaccines (H1c) were relevant variables in predicting COVID vaccination status. We conducted a binary logistic regression, entering general vaccine stance, flu vaccine frequency, and COVID vaccine attitudes as predictors and COVID vaccination status as the outcome. These three variables alone produced a model that was both significant ($\chi^2(3)=435.68, p<.001$) and a 52.7% improvement over the null model. The odds of those having a positive stance toward general vaccination also having received the COVID vaccine were 3.61 times higher than the odds of them being unvaccinated (99% CI=2.17; 6.02; Wald=41.86, $p<.001$). Additionally, those who received the flu vaccine regularly had 2.98 times higher odds of being vaccinated than did those who did not receive the flu vaccine regularly (99% CI=1.82; 4.86; Wald=32.81, $p<.001$). Finally, the odds that those with more positive attitudes toward the COVID vaccine were vaccinated were 5.34 times higher than those with less positive attitudes (99% CI=3.54; 8.03; Wald=111.15, $p<.001$). The model accurately classified 68.7% of the unvaccinated and 88.5% of the vaccinated (overall accuracy = 82.0%). As such, all three variables were significantly predictive of COVID vaccination status, supporting H1a, H1b, and H1c.

Follow-up analyses were conducted to examine RQ1. We conducted a multi-block binary logistic regression. In Block 1, we entered general vaccine attitudes and flu shot frequency as control variables (given both were significant in the prior analysis). In Block 2 we entered the four COVID vaccine attitude items as individual predictors using a conditional forward selection

analysis (p to enter=.01; p to remove=.05; RQ1). After controlling for general vaccine attitudes and flu shot frequency, there were two specific COVID vaccine attitude items that contributed significantly to the prediction of whether respondents were vaccinated. When respondents felt the benefits being worth the risks ($OR=2.37$, 99% CI=1.73; 3.26, Wald=49.03, $p<.001$) and that there was sufficient evidence of the vaccine's safety ($OR=1.88$, 99% CI=1.37; 2.57, Wald=26.98, $p<.001$), they were more likely to report being vaccinated. The overall model demonstrated a 53.2% improvement over the null model ($\chi^2(4)=441.47$, $p<.001$) and was able to classify 68.0% of those who were unvaccinated and 88.8% of those who were vaccinated (overall accuracy=82.0%), similar to the model that used the full COVID vaccine attitudes scale.

Trust in Various Information Sources

H2, H3, RQ2, and H4 all concerned the potential role of trust in various information sources. We began by comparing those who were vaccinated and those who were not in terms of their trust in information from various sources (Table 2). In support of H2, those who were vaccinated reported significantly more trust in different information sources (and in trust overall) than did those who were unvaccinated.

We then tested H3 by conducting a binary logistic regression using the four sources of information in a forward conditional analysis to predict vaccination status (p to enter = .01; p to remove = .05). Trust in government and trust in scientists resulted in a model that was a 34.7% improvement over the null model ($\chi^2(2)=262.56$, $p<.001$), supporting H3a and H3b. Odds ratios were 2.17 (99% CI=1.45; 3.24, Wald=24.72, $p<.001$) and 2.52 (99% CI=1.70; 3.72, Wald=37.23, $p<.001$), respectively. However, trust in one's doctor was not a significant predictor, contrary to H3c. The final model accurately classified 67.0% of those who were unvaccinated and 78.8% of those who were vaccinated (overall accuracy=74.9%).

To test RQ2, we then conducted a multi-block binary logistic regression. In Block 1 we entered vaccine attitudes, flu shot frequency, and COVID vaccine attitudes. In Block 2 we entered trust in government and trust in scientists. The results indicated that neither trust in government ($OR=1.44$, 99% $CI=0.89$; 2.32 , $Wald=3.88$, $p=.049$), nor trust in scientists ($OR=1.03$, 99% $CI=0.63$; 1.66 , $Wald=0.02$, $p=.888$) added significantly to the prediction of vaccination status.

We then tested H4 to determine whether trust in different information sources was predictive of COVID vaccine attitudes. Given the significant correlation among the trust facets, we conducted a forward selection regression analysis (p to enter = .01; p to remove = .05) entering the four sources of trust as possible predictors and COVID vaccine attitudes as the outcome. Trust in scientists explained 54.8% of the variance in COVID vaccine attitudes ($R=.740$, $F(1, 915)=1110.79$, $p<.0001$). Both trust in government and trust in one's doctor also explained significant variance in respondents' COVID vaccine attitudes (top panel Table 3), supporting H4a, H4b, and H4c. Therefore, although trust does not appear to be a primary driver of actual vaccination, it does appear to be a predictor of people's attitudes toward the COVID vaccines.

COVID Conspiracies and Pseudoscience Beliefs

To test H5a and H6a, we conducted a binary logistic regression, entering both COVID conspiracy and pseudoscience beliefs as predictors and vaccination status as the dependent variable. Stronger endorsement of COVID conspiracies ($OR=.62$, 99% $CI=.52$; $.74$, $Wald=50.03$, $p<.001$) and stronger beliefs in pseudoscience ($OR=.65$, 99% $CI=.45$; $.94$, $Wald=9.22$, $p<.005$) were associated with greater propensity to be unvaccinated. However, the model was not as effective as prior models, demonstrating only a 14.4% improvement over the null ($\chi^2(2)=100.02$,

$p < .001$). Additionally, it was only effective in classifying 66.0% of those who were not vaccinated and 67.7% of those who were (overall accuracy = 67.2%).

We then followed up with a multi-block binary logistic regression. In Block 1 we entered vaccine attitudes, flu shot frequency, and COVID vaccine attitudes. In Block 2 we entered COVID conspiracy and pseudoscience beliefs using a forward conditional method (p to enter = .01; p to remove = .05). After controlling for the Block 1 variable group, neither COVID conspiracy nor pseudoscience beliefs helped to predict vaccination status.

To test H5b and H6b, we conducted a multiple regression analysis, entering COVID conspiracy and pseudoscience beliefs as Block 1 predictors and COVID vaccine attitudes as the outcome. We then entered the three trust facets from our earlier analysis into Block 2 to determine whether, in a final analysis, COVID conspiracies and pseudoscience beliefs offered explained variance beyond that explained by relevant trust factors (Table 2 bottom panels). In support of H5b and H6b, both COVID conspiracy and pseudoscience beliefs were significant predictors of COVID vaccine attitudes, together explaining 18.0% of the variance in vaccine attitudes. However, once the three trust facets were entered, only pseudoscience beliefs explained unique variance, suggesting that COVID conspiracies may be more important to the prediction of trust as opposed to the direct prediction of COVID vaccine attitudes.

Finally, to test H5c and H6c, we conducted a series of regression analyses (Table 4). In support of both hypotheses, COVID conspiracies and pseudoscience beliefs were significantly predictive of trust in different COVID information sources. The lone exception was pseudoscience being nonsignificant in the regression analysis predicting trust in information from news sources. There were relatively consistent predictive effects for COVID conspiracies and pseudoscience beliefs when it came to trust in COVID information from government,

scientists, and one's doctor. Thus, it appears that those who possess a more conspiracist or pseudoscientific mindset tend to be generally less trusting of information from various sources when it comes to COVID.

Additional Exploratory Analyses

Subsequent analyses were designed to explore RQ4, RQ5, and RQ6. To explore RQ4, we simply examined the percentage of those who were unvaccinated who also reported that they probably or definitely would get vaccinated. Of the 300 respondents who reported they were unvaccinated, 88 (29.3%) reported that they probably or definitely would get vaccinated, while the other 73.3% reported they definitely or probably would not get vaccinated. To explore RQ5, we conducted an analysis of the possible reasons for vaccine hesitancy (from Appendix D) and compared the frequency of responses based on those who reported they were likely to vaccinate and those who were not (Table 5). Those who were unlikely to get vaccinated were much more likely to report distrust in the science of vaccines, believe the pandemic is a hoax, and report not believing the vaccine would benefit them. Those who were likely to get vaccinated were much more likely to report they didn't know which vaccine to get, that they were waiting for the community to reopen, and that they simply had not made the time. It is noteworthy that both groups were equally likely to report concerns about short- and long-term side effects, serious vaccine reactions, and safety and effectiveness results, with those responses being endorsed by either a majority or sizable minority of respondents.

Finally, to explore RQ6, we conducted a comparison of those who were likely to get vaccinated from those who were not to determine if there were differences among the groups (due to small sample sizes, we could not conduct binary logistic regressions confidently; Table 6). The group that was likely to get vaccinated differed from the group that was unlikely to get

vaccinated based on all the primary study variables except for COVID conspiracy and pseudoscience beliefs. The final column of Table 6, however, indicates that although the higher likelihood group possessed characteristics that favored future vaccination (e.g., higher frequency counts of those with positive vaccine attitudes, stronger trust scores), these characteristics were still much less favorable than those who had already been vaccinated (e.g., difference in mean vaccine attitude scores, trust in scientists).

Discussion

The results reported here suggest several conclusions regarding the decision of whether to receive the COVID vaccine. Here, we specifically focus on four conclusions: (1) vaccine-related attitudes and prior vaccination behavior predicted current decisions concerning the COVID vaccine; (2) trust in various information sources was more important for predicting COVID vaccine attitudes than they were actual vaccination; (3) belief in COVID conspiracies and pseudoscience explained some, but not the majority of, variance in important outcomes; and (4) the majority of those who are unvaccinated are unlikely to decide on their own to get vaccinated in the future. Each poses implications for future efforts to increase overall vaccination rates.

The first conclusion concerns the predictiveness of vaccine-related attitudes and prior vaccination behavior on current decisions concerning the COVID vaccine. Those who chose to be vaccinated possessed more positive views of vaccines in general, regularly received their annual flu vaccine, and held more positive attitudes about the COVID vaccines specifically. These three variables alone allowed us to predict, with over 80% accuracy, which respondents were likely to be vaccinated and which were not. The two most relevant aspects of positive COVID vaccine attitudes concerned respondents' belief that the benefits were worth the risks and that there was sufficient evidence of the vaccines' safety. Interestingly, none of the

individual predictors themselves demonstrated overwhelmingly strong predictive utility as the largest bivariate correlation for any of the predictors was .57 (for vaccine attitudes). This finding suggests that it is overly simplistic to conclude that all who have not received the vaccine are anti-vaccine or anti-science.

Second, although the various trust indicators showed moderate to strong correlations with vaccination in a bivariate way, they were not directly predictive of vaccination status. Rather, trust in scientists studying and communicating about COVID was a strong predictor of COVID vaccine attitudes. Trust in government and trust in one's doctor both added significant variance to the prediction of COVID vaccine attitudes, with the three together accounting for more than half the variance in COVID vaccine attitudes. It is important to also note that trust in various news sources was nonsignificant in most analyses conducted, suggesting that news consumption, for most people, was less important than information consumed from scientists, government officials, and doctors. Some (maybe many) of the news sources would have contained secondhand information from those other sources (explaining some of the strong correlation across the various trust domains), but it appears that the news media, by itself, was not chiefly responsible for explaining any of the relevant outcomes in the current study.

The third conclusion is that, although we expected belief in COVID conspiracies and pseudoscience to explain significant variance in vaccination decisions, this turned out to not be the case. Both showed only weak, though significant, bivariate associations with the decision to get vaccinated thus far. Without controlling for any other variables, both COVID conspiracy and pseudoscience beliefs explained about 14% of the variance in vaccination decision. When other constructs were entered (i.e., vaccine attitudes, flu shot frequency, COVID vaccinate attitudes), both became nonsignificant predictors. Instead, the results suggested that these two beliefs might

be better predictors of COVID vaccine attitudes. Pseudoscience beliefs was a significant predictor of COVID vaccine attitudes after controlling for relevant trust factors (whereas COVID conspiracy beliefs was not), but the association was weak. It turned out that both belief variables were generally significant predictors of trust in COVID-related information from various sources, with the strongest overall prediction occurring for trust in scientists. Overall, though, the two variables only explained between 3.0% and 16.6% of the variance in trust, meaning that while they did help to differentiate those who were more trusting of relevant COVID-related information from those who were not, many other factors likely play a role.

Finally, when we looked at only those who were unvaccinated, we found that the majority were unlikely to decide to receive the COVID vaccine. Approximately 73% of the unvaccinated respondents in our study indicated a low probability of deciding freely to receive the COVID vaccine. Although large percentages of respondents in both groups of unvaccinated individuals reported concerns about long-term side effects, overall effectiveness, COVID vaccine safety, and likelihood of severe COVID symptoms should they contract the virus, the strongest differentiating reasons (among the two unvaccinated groups) for those who remained vaccine resistant concerned a general distrust of the science of vaccines, a belief the vaccine would not benefit them, and, to a lesser extent, the belief the pandemic is a hoax. Those who reported they likely planned to get vaccinated in the future demonstrated strong uncertainty about which vaccine they should get, a failure to have made the time to get vaccinated, and, to a lesser extent, intentions to wait until the community re-opens. Follow-up analyses also indicated that the two unvaccinated groups differed significantly on all primary study variables except COVID conspiracy and pseudoscience beliefs. Yet, those who were likely to get vaccinated in the future still demonstrated suppressed levels of positive vaccine attitudes, flu shot frequency, and trust, as

well as higher levels of COVID conspiracy and pseudoscience beliefs, relative to those who were already vaccinated.

Our results are consistent with those reported by El-Elimat et al. (2021), Wolff (2021), Kreps et al. (2021), and others that have pointed toward people's general attitudes toward vaccination, their frequency of opting to receive annual flu vaccines, and attitudes and beliefs about the COVID vaccines specifically (especially regarding their effectiveness and safety) as strong antecedents of COVID vaccination. Although positive attitudes about the COVID vaccine as an antecedent to vaccination is an intuitive result, it is also unsurprising that having stronger views about vaccines in general and being more willing to receive annual flu vaccinations were important antecedents. Prior research has shown that the stronger the attitude and the more frequently individuals behave consistently with that attitude, the more likely that attitude is to predict future behavior (Kraus, 1995). It is important to note, though, that the correlation between attitudes and behavior observed by Kraus (1995) in a meta-analysis was only .38, suggesting that although attitudes influence behavior, they also show some independence from that behavior, which was also observed in our study (though the correlation between general vaccinate attitudes/COVID vaccine attitudes and actual vaccination status in the current study was higher than the correlation observed by Kraus).

Although acceptance of pseudoscience beliefs or COVID conspiracies are often pointed to as strong primary differentiators among those who have chosen to vaccinate and those who have not (e.g., Juanchich et al., 2021; Jennings et al., 2021), our results indicate that both variables are, at most, distal predictors of vaccination decisions. Rather, acceptance of conspiracies and pseudoscience beliefs appear to be only a small component of vaccine hesitancy. Instead, what we found was that both variables do a better job of explaining the

amount of trust individuals place in various institutions and professions, such as government and scientists, than they do actual vaccination status. These trust factors are then predictive of the attitudes people hold toward the COVID vaccines.

This is not to say that acceptance of conspiracy theories and pseudoscience are irrelevant to the discussion of vaccination. However, given that those who hold such beliefs tend to also distrust the government, news media, and scientists, attempts to address those beliefs by using the same types of sources these individuals distrust is fraught with challenges. Though we did not directly measure it, social media consumption (as opposed to mainstream media) as a primary source of information has been shown to be more predictive of COVID vaccine hesitancy (Jennings et al., 2021; Piltch-Loeb et al., 2021). Whether attempts to flag misinformation in social media posts (as recently done by several social media companies) has the potential to alter people's beliefs in conspiracy theories and pseudoscience, and in which direction, is still an open research question.

The current trends in COVID vaccination rates echo trends reported by Yaqub et al. (2014) regarding other vaccines. They found that hesitancy for various vaccines was prevalent, even among people who still decided to be vaccinated. They pointed toward a lack of trust in various institutions that are involved in vaccine programs (e.g., government, pharmaceutical companies) as primary drivers of hesitancy. Although our results do not point toward those trust factors specifically, trust in different information sources (e.g., scientists, government) were important antecedents of people's attitudes toward the COVID vaccines (though there was a lot of overlap among trust constructs, indicating that some amount of trust might be a function of individual differences in trait trustingness). Additionally, we found that the two most important elements of people's attitudes toward the COVID vaccines was their beliefs the vaccines were

safe and that the benefits outweighed the risks. Coupled with the results of Yaqub et al. (2014), future attempts to improve vaccination rates could involve the provision of very specific (but easily digestible) information about the risks and benefits of vaccination, as opposed to exalting the benefits of vaccination while neglecting to address legitimate concerns individuals hold regarding safety and side effects. Providing balanced information to address expressed concerns may provide individuals with the confidence to proactively decide and act upon decisions regarding vaccine uptake.

Whether or not to take the vaccine is not the only decision with which individuals are confronted. Additionally, the information provided should help hesitant individuals make informed choices about which vaccine to opt for. Unlike past vaccination efforts, when it comes to COVID, there are several different vaccine choices available, each with a different research base, effectiveness results, and safety profile. More than half of those who intended to get vaccinated but had not yet done so were uncertain about which vaccine they should get. Providing easily digestible information to help individuals make informed choices about which vaccine might be best for them could assist in improving vaccination rates.

Ultimately, though, as the important role of trust in sources demonstrates, the effectiveness of these information dissemination efforts may depend upon who is creating and disseminating the information. Disseminating information from untrusted sources may fail to address the concerns hesitant or resistant individuals have. As such, it may be important to better understand what sources the hesitant and resistant do trust and take steps to use those sources for conveying the digestible information. Alternatively, it may be worthwhile to begin understanding why certain sources are not trusted (e.g., benevolence-based, competence-based; Mayer et al., 1995) and how these institutions and professions can restore public trust within the

subpopulation of individuals whose vaccination hesitancy stems from this mistrust. One step towards restoring this trust may be by providing direct and balanced information, as mentioned above, to address concerns shared by more than half of those who were unvaccinated about the documented side effects and acknowledging the legitimacy of ongoing concerns regarding the unknown long-term side effects.

Limitations & Future Directions

The current study shed some insight into factors that differentiate those who have made the choice to receive the COVID vaccination from those who have not. However, this study, like all studies, possesses some limitations that may benefit from additional research. The primary limitations we discuss here are the cross-sectional nature of the study and the lack of additional psychological constructs that may be relevant.

First, the current study was conducted as a snapshot in time. Although such a snapshot provides a good way to better understand the status of individuals and potential correlates of outcomes at that point in time, such studies are unable to assess potential change over time, especially because of changes in the dynamic of the pandemic (e.g., full FDA approval of various vaccines, new virus variants). Fridman et al. (2021) demonstrated that respondents' trust in various media sources (e.g., media, government) can fluctuate over time, though their study results show only modest changes over a period of months. It would, however, be advantageous to see how changes to the pandemic landscape alters the decisions people make regarding vaccination (and future booster shots).

Second, although the current study included a variety of variables that were helpful for explaining vaccination status, vaccine attitudes, and trust in various information sources, it did not include other psychological constructs that may be relevant. For example, we found that the

various trust factors were moderately to strongly correlated, and constructs such as trust propensity (e.g., Frazier et al., 2013) could help explain some of this correlation. Additionally, measures of statistical and science literacy (e.g., Gigerenzer et al., 2008) could potentially be used to aid in understanding the conclusions that different individuals draw regarding vaccine safety and efficacy. Finally, constructs that assess various decision-relevant factors (e.g., risk aversion, biases for and against vaccines) could be beneficial for better understanding the criteria against which individuals weigh various pieces of information. While the current study assessed some similar constructs (e.g., positive vaccine stance may bias people toward accepting new vaccines, given our results), a further exploration of decision-making constructs in the context of vaccination decisions is certainly warranted.

Conclusion

The results of the current study help to advance our overall understanding of the decisions people have made regarding COVID vaccination. It appears likely that those who had strong positive attitudes toward vaccinations in general and who regularly displayed behaviors consistent with those attitudes (by getting their flu shots) were those most likely to be vaccinated. Additionally, individuals who believed in the safety of the vaccines and who possessed more positive benefit/risk assessments were more likely to make the decision to vaccinate. Among the hesitant (as opposed to the resistant) there appears to be possible avenues for improving vaccine literacy, especially when it comes to helping those individuals to make an informed decision as to which of the vaccines may be the right choice for them.

References

- Arghittu, A., Dettori, M., Azara, A., Gentili, D., Serra, A., Contu, B., & Castiglia, P. (2020). Flu vaccination attitudes, behaviours, and knowledge among health care workers. *International Journal of Environmental Research and Public Health*, 17(9), article 3185. <https://doi.org/10.3390/ijerph17093185>
- Centers for Disease Control and Prevention. (2016, October 6). *VaxView vaccination coverage*. Centers for Disease Control and Prevention. Retrieved September 14, 2021, from <https://www.cdc.gov/vaccines/vaxview/index.html>
- El-Elimat, T., AbuAlSamen, M. M., Almomani, B. A., Al-Sawalha, N. A., & Alali, F. Q. (2021). Acceptance and attitudes toward COVID-19 vaccines: A cross-sectional study from Jordan. *PLOS ONE*, 16(4), article e0250555. <https://doi.org/10.1371/journal.pone.0250555>
- Frazier, M. L., Johnson, P. D., and Fainshmidt, S. (2013). Development and validation of a propensity to trust scale. *Journal of Trust Research*, 3, 76–97. <https://doi.org/10.1080/21515581.2013.820026>
- Freeman, D., Waite, F., Rosebrock, L.,....& Lambe, S. (2020). Coronavirus beliefs, mistrust, and compliance with government guidelines in England. *Psychological Medicine, [First View]*, 1-13. <https://doi.org/10.1017/S0033291720001890>
- Fridman, A., Gershon, R., & Gneezy, A. (2021). COVID-19 and vaccine hesitancy: A longitudinal study. *PLOS ONE*, 16(4), article e0250123. <https://doi.org/10.1371/journal.pone.0250123>
- Garry, J., Ford, R., & Johns, R. (2020). Coronavirus conspiracy beliefs, mistrust, and

- compliance: Taking measurement seriously. *Psychological Medicine [First View]*, 1-11.
<https://doi.org/10.1017/S0033291720005164>
- Gigerenzer, G., Gaissmaier, W., Kurz-Milcke, E., Schwartz, L. M., & Woloshin, S. (2008). Helping doctors and patients make sense of health statistics. *Psychological Science in the Public Interest*, 8(2), 53-96. <https://doi.org/10.1111/j.1539-6053.2008.00033.x>
- Glasman, L. R., & Albarracin, D. (2006). Forming attitudes that predict future behavior: A meta-analysis of the attitude-behavior relation. *Psychological Bulletin*, 132(5), 778-822.
<https://doi.org/10.1037/0033-2909.132.5.778>
- Jennings, W., Stoker, G., ...Mills, M. C. (2021). Lack of trust, conspiracy beliefs, and social media use predict COVID-19 vaccine hesitancy. *Vaccines*, 9(6), article 593.
<https://doi.org/10.3390/vaccines9060593>
- Juanchich, M., Sirota, M., Jolles, D., & Whiley, L. A. (2021). Are COVID-19 conspiracies a threat to public health? Psychological characteristics and health protective behaviours of believers. *European Journal of Social Psychology*. <https://doi.org/10.1002/ejsp.2796>
- Kraus, S. J. (1995). Attitudes and prediction of behavior: A meta-analysis of the empirical literature. *Personality and Social Psychology Bulletin*, 21(1), 58-75.
<https://doi.org/10.1177/0146167295211007>
- Kreps, S., Dasgupta, N., Brownstein, J. S., Hswen, Y., & Kriner, D. L. (2021). Public attitudes toward COVID-19 vaccination: The role of vaccine attitudes, incentives, and misinformation. *npj Vaccines* 6, article 73. <https://doi.org/10.1038/s41541-021-00335-2>
- Lobato, E., Mendoza, J., Sims, V., & Chin, M. (2014). Examining the relationship between

conspiracy theories, paranormal beliefs, and pseudoscience acceptance among a university population. *Applied Cognitive Psychology*, 28, 617-625.

<https://doi.org/10.1002/acp.3042>

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integration model of organizational trust. *Academy of Management Review*, 20, 709-734.

Mayo Clinic. (2021). U.S. COVID-19 vaccine tracker: See your state's progress.

<https://www.mayoclinic.org/coronavirus-covid-19/vaccine-tracker>

Murphy, J., Vallieres, F., Bentall, R. P.,...& Hyland, P. (2021). Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nature Communications*, 12, article 29. <https://doi.org/10.1038/s41467-020-20226-9>

Piltch-Loeb, R., Savoia, E., ...& Testa, M. (2021). Examining the effect of information channel on COVID-19 vaccine acceptance. *PLOS ONE*, 16(5), article e0251095.

<https://doi.org/10.1371/journal.pone.0251095>

Roozenbeek, J., Schneider, C. R., ...& van der Linden, S. (2020). Susceptibility to misinformation about COVID-19 around the world. *Royal Society Open Science*, 7(10), article 201199. <https://doi.org/10.1098/rsos.201199>

Soveri, A., Karlsson, L. C., ... & Lewandowsky, S. (2020). Trait reactance and trust in doctors as predictors of vaccination behavior, vaccine attitudes, and use of complementary and alternative medicine in parents of young children. *PLOS ONE* 15(7), article e0236527.

<https://doi.org/10.1371/journal.pone.0236527>

Taylor, S., Landry, C. A., Paalusz, M. M., Groenewoud, R., Rachor, G. S., & Asmundson, G. J. G. (2020). A proactive approach for managing COVID-19: the importance of

- understanding the motivational roots of vaccination hesitancy for SARS-CoV2. *Frontiers in Psychology*, 11, article 575950. <https://doi.org/10.3389/fpsyg.2020.575950>
- Teovanović, P., Lukić, P., Zupan, Z., Lazić, A., Ninković, M., & Žeželj, I. (2021). Irrational beliefs differentially predict adherence to guidelines and pseudoscientific practices during the COVID-19 pandemic. *Applied Cognitive Psychology*, 35(2), 486-496. <https://doi.org/10.1002/acp.3770>
- USAFacts. (2021). US Coronavirus vaccine tracker. <https://usafacts.org/visualizations/covid-vaccine-tracker-states/>
- Wolff, K. (2021). COVID-19 vaccination intentions: The Theory of Planned Behavior, optimistic bias, and anticipated regret. *Frontiers in Psychology*, 12, article 648289. <https://doi.org/10.3389/fpsyg.2021.648289>
- Yaqub, O., Castle-Clarke, S., Sevdalis, N., & Chataway, J. (2014). Attitudes to vaccination: A critical review. *Social Science and Medicine*, 112, 1-11. <https://doi.org/10.1016/j.socscimed.2014.04.018>

Table 1. Descriptive statistics for all primary study variables

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Flu Vax Freq.	0.62	0.49											
2. Gen. Vax Stance	0.57	0.49	.38*										
3. Vaccinated	0.67	0.47	.38*	.51*									
4. Vax Likelihood ^a	0.27	0.44	.32*	.40*	---								
5. Pseudoscience	2.84	0.62	-.13*	-.31*	-.22*	-.02							
6. COVID Vax Att.	2.91	0.78	.29*	.51*	.57*	.35*	-.35*						
7. Trust Overall	2.69	0.75	.31*	.51*	.51*	.39*	-.26*	.73*					
8. Trust: Gov't	2.61	0.82	.27*	.46*	.48*	.35*	-.24*	.68*	.94*				
9. Trust: News	2.47	0.88	.27*	.36*	.41*	.34*	-.13*	.55*	.86*	.75*			
10. Trust: Scientists	2.88	0.86	.29*	.53*	.49*	.37*	-.31*	.74*	.89*	.78*	.66*		
11. Trust: Doctor	3.01	0.86	.25*	.41*	.38*	.26*	-.27*	.56*	.71*	.59*	.48*	.64*	
12. COVID Conspir.	2.29	1.21	-.18*	-.46*	-.32*	-.12*	.46*	-.37*	-.33*	-.30*	-.18*	-.38*	-.33*

Note: * is significant at the .01 level; alpha coefficients appear in italics along the diagonal; ^a Question posed only to those unvaccinated; Flu Vax Freq. = Flu Vaccination Frequency (1=Almost always and usually; 0=Never or usually not); Gen. Vax Stance = General Stance Toward Vaccination (1=Fully Supports; 0=No opinion or does not fully support); Vaccinated (1=Full or Partially; 0=Not Vaccinated); Vax Likelihood = Likelihood for unvaccinated to get vaccinated (1=Probably or Definitely Yes; 0=Probably or Definitely No); COVID Vax Att. = Attitudes toward COVID vaccine; COVID Conspir. = Endorsement of COVID conspiracies.

Table 2. Mean comparisons of trust in information based on vaccination status.

Information Source	Unvaccinated (<i>n</i> =300)		Vaccinated (<i>n</i> =617)		<i>t</i>
	Mean	SD	Mean	SD	
Overall	2.15	0.71	2.96	0.60	18.04**
Government	2.06	0.77	2.88	0.69	16.38**
News Media	1.95	0.84	2.72	0.79	13.50**
Scientists	2.27	0.82	3.17	0.70	17.13**
One's Doctor	2.54	0.89	3.24	0.75	12.47**

*is significant at the .001 level; tests whether the scores for the vaccinated group is higher than the scores for the unvaccinated group.

Table 3. Regression Results Predicting COVID Vaccine Attitudes.

Variable	B	CI	SE	β	t	p
Model 1: Trust Factor Predictors						
Trust in Scientists	.45	.36; .53	.03	.49	13.37	.000
Trust in Government	.23	.14; .32	.03	.24	6.97	.000
Trust in Doctor	.09	.02; .16	.03	.10	3.55	.000
Model 2: Multi-Step						
<i>Step 1</i>						
COVID Conspiracies	-.17	-.23; -.12	.02	-.27	-7.92	.000
Pseudoscience Beliefs	-.29	-.40; -.18	.04	-.23	-6.81	.000
<i>Final Step</i>						
COVID Conspiracies	-.03	-.08; .01	.02	-.05	-2.22	.027
Pseudoscience Beliefs	-.14	-.22; -.06	.03	-.11	-4.54	.000
Trust in Scientists	.40	.32; .49	.03	.44	12.13	.000
Trust in Government	.23	.15; .32	.03	.25	7.25	.000
Trust in Doctor	.07	.01; .14	.03	.08	2.84	.005

Model 1 Step 1: $R = .740$, $R^2 = .548$, $F(1, 915) = 1110.79$, $p < .001$

Model 1 Step 2: $R = .759$, $R^2 = .576$, $F(2, 914) = 620.86$, $p < .001$

Model 1 Step 3: $R = .763$, $R^2 = .582$, $F(3, 913) = 423.41$, $p < .001$

Model 2 Step 1: $R = .424$, $R^2 = .180$, $F(2, 914) = 100.20$, $p < .001$

Model 2 Final Step: $R = .774$, $R^2 = .599$, $F(5, 911) = 272.06$, $p < .001$

Table 4. Regression Results Predicting Trust in COVID Information from Different Sources.

Variable	B	CI	SE	β	t	p
Model 1: Overall Trust						
COVID Conspiracies	-.17	-.22; -.11	.02	-.27	-7.72	.000
Pseudoscience Beliefs	-.17	-.28; -.06	.04	-.14	-4.06	.000
Model 2: Trust in Government						
COVID Conspiracies	-.16	-.23; -.10	.02	-.16	-6.92	.000
Pseudoscience Beliefs	-.17	-.29; -.05	.05	-.17	-3.56	.000
Model 3: Trust in News						
COVID Conspiracies	-.11	-.18; -.04	.03	-.16	-4.28	.000
Pseudoscience Beliefs	-.09	-.22; .05	.05	-.06	-1.66	.098
Model 4: Scientists						
COVID Conspiracies	-.21	-.27; -.15	.02	-.21	-8.72	.000
Pseudoscience Beliefs	-.24	-.36; -.12	.05	-.24	-5.15	.000
Model 5: Trust in One's Doctor						
COVID Conspiracies	-.18	-.25; -.12	.02	-.26	-7.44	.000
Pseudoscience Beliefs	-.21	-.33; -.08	.05	-.15	-4.30	.000

Model 1 $R = .356$, $R^2 = .127$, $F(2, 914) = 66.30$, $p < .001$

Model 2 $R = .321$, $R^2 = .103$, $F(2, 914) = 52.54$, $p < .001$

Model 3 $R = .192$, $R^2 = .037$, $F(2, 914) = 17.40$, $p < .001$

Model 4 $R = .407$, $R^2 = .166$, $F(2, 914) = 90.95$, $p < .001$

Model 5 $R = .353$, $R^2 = .125$, $F(2, 914) = 65.10$, $p < .001$

Table 5. Comparison of List of Reasons for Vaccine Hesitancy by Future Vaccination Likelihood.

Reason	Probably/Definitely No (n=220)		Probably/Definitely Yes (n=80)		χ^2
	Count	% of Group	Count	% of Group	
Concerns about long-term side effects	152	69.1%	43	53.8%	6.07
Don't know which vaccine to get	38	17.3%	41	51.2%	34.91***
Distrust science of vaccines	92	41.8%	17	21.3%	10.73**
Not made time	29	13.2%	42	52.5%	50.20***
Concerns about serious vaccine reactions	144	65.5%	45	56.3%	2.13
Concerns about short-term side effects	104	47.3%	41	51.2%	0.37
Believe pandemic is a hoax	83	37.7%	14	17.5%	10.97***
Waiting for more effectiveness results	124	56.4%	44	55.0%	0.04
Doctor advises against it	34	15.5%	5	6.3%	4.39
Waiting for more safety results	126	57.3%	49	61.3%	0.38
Waiting for community to reopen	33	15.0%	28	35.0%	14.49***
Unlikely to have severe COVID symptoms	104	47.3%	35	43.8%	0.29
Don't believe vaccine will benefit me	142	64.5%	10	12.5%	63.58***

Note: all χ^2 analyses had df=1; * is significant at the .01 level; ** is significant at the .005 level; *** is significant at the .001 level

Table 6. Comparisons of those who planned to get vaccinated and those who did not.

Information Source	Unlikely (<i>n</i> =220)		Likely Vaccination (<i>n</i> =88)		<i>Chi-Squared</i>	Vaccinated (<i>n</i> =617)	
	N	%	N	%		N	%
Positive Vaccine Stance	25	11.4%	39	48.8%	48.86*	461	74.7%
Flu Vaccine Regularly	58	26.4%	49	61.3%	31.12*	461	74.7%
	Mean	SD	Mean	SD	<i>t</i> ^a	Mean	SD
COVID Vaccine Beliefs	2.12	0.72	2.70	0.61	6.45*	3.22	0.59
Overall Trust	1.98	0.68	2.60	0.59	7.28*	2.96	0.60
Trust in Government	1.89	0.73	2.50	0.72	6.44*	2.88	0.69
Trust in News	1.78	0.78	2.42	0.80	6.22*	2.72	0.79
Trust in Scientists	2.09	0.80	2.77	0.66	6.81*	3.17	0.70
Trust in One's Doctor	2.40	0.93	2.92	0.65	4.61*	3.24	0.75
COVID Conspiracies	2.93	1.06	2.61	1.23	2.18	2.03	1.16
Pseudoscience Beliefs	3.04	0.52	3.02	0.57	0.27	2.74	0.63

*is significant at the .001 level; ^a analyses conducted via bootstrapping, tests whether the scores for the likely to be vaccinated group is higher than the scores for the unlikely to be vaccinated group.

Appendix A
COVID- & Vaccine-Specific Items

Please indicate your current COVID vaccination status?

- Fully Vaccinated (received both doses of a 2-dose vaccine or one single-dose vaccine)
(coded as 1)
- Partially Vaccinated (received the first of a 2-dose vaccine) (coded as 1)
- Unvaccinated (coded as 0)

1 = fully or partially vaccinated, 0 = unvaccinated

How likely are you to get the COVID vaccine? (*provided only to those who reported being unvaccinated*)*

- Definitely will get vaccinated (coded as 1)
- Probably will get vaccinated (coded as 1)
- Probably will not get vaccinated (coded as 0)
- Definitely will not get vaccinated (coded as 0)

1 = probably or definitely will get vaccinated, 0 = probably or definitely will not get vaccinated

Were/Are you considered high risk due to health status?

Were/Are you considered high risk due to age?

- Yes (coded as 1)
- No (coded as 0)
- Don't Know (coded as missing)

1 = yes, 0 = no

How often do you get the annual **flu** vaccine?

- I always get the flu vaccine (coded as 1)
- I usually get the flu vaccine (coded as 1)
- I usually **don't** get the flu vaccine (coded as 0)
- I never get the flu vaccine (coded as 0)

1 = Always or usually get the flu vaccine, 0 = never or usually do not get the flu vaccine

What is your stance on CDC recommended vaccines (e.g., MMR)?

- Everyone who can be (i.e., no risk factors like weakened immune system) should get vaccinated (coded as 1)

Only people highly at risk should get them due to safety concerns (coded as 0)

No one should have them due to safety concerns (coded as 0)

No strong opinion (coded as 0)

1=Strong positive stance toward vaccination, 0=Not a strong positive stance on vaccination

Have you ever been diagnosed with COVID?

Yes (coded as 1)

No (coded as 0)

Prefer not to answer (coded as missing)

1 = yes, 0 = no

*Item adapted from the CDC's vaccine hesitancy item.

Appendix B
COVID Vaccine Attitudes

Instructions: This set of items relates to beliefs you may hold about the COVID vaccines. For each item, please indicate the degree to which you agree with each statement.

There is sufficient evidence to suggest the COVID vaccines are generally safe.

There is sufficient evidence to suggest the COVID vaccines are generally effective.

The benefits of receiving the vaccine are worth any possible short-term risks.

The COVID vaccine lowers the risk to otherwise healthy people in case they should contract the disease.

Appendix C

Trust in Various Sources

Instructions: This set of items relates to trust you place in various sources as it concerns information about COVID. For each item, please indicate the degree to which you agree with each statement.

- I have confidence in the information disseminated by the Centers for Disease Control and Prevention (CDC) about COVID.
- I have confidence in the decisions made by the *federal* government as it concerns COVID safety guidelines.
- I have confidence in the decisions made by my *state* government as it concerns COVID safety guidelines.
- I have confidence in the information the *national* news media provides about COVID.
- I have confidence in the information the local news media provides about COVID.
- I have confidence in the scientists conducting research studies on the COVID virus.
- I have confidence in the scientists communicating information about COVID.
- I have confidence in the advice of my doctor as it concerns COVID.

Appendix D
List of Possible Reasons for Vaccine Hesitancy

Instructions: The next set of items concern possible reasons you might be unvaccinated. For each reason, please indicate if this is a reason you have chosen not to receive the COVID vaccine.

- I am awaiting further results about the vaccine's safety.
- I am awaiting further results about the vaccine's effectiveness.
- I do not believe I will benefit from receiving the vaccine.
- I have concerns about the possible short-term side effects (flu-like symptoms, soreness, fever).
- I have concerns about the possible long-term side effects.
- I have concerns about a serious adverse reaction (e.g., blood clots, paralysis, death).
- I distrust the science of vaccines.
- My doctor advises against it.
- I am putting vaccination off until my community begins to re-open more fully.
- I believe the entire COVID pandemic is based on a hoax.
- I am unlikely to have severe symptoms if I should contract COVID.
- I do not know which of the available vaccines I should get.
- I have simply not made the time to make an appointment.

Response options were yes and no, coded as 1=yes and 0=no.