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RESEARCH ARTICLE



## Understanding motivations and deterrents for COVID-19 vaccination among US working adults: A mixed method approach

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### ABSTRACT

COVID-19 vaccines have been developed and administered in the United States. Despite evidence from clinical trials for the effectiveness of the COVID-19 vaccines, many individuals are still hesitant or even unwilling to receive one. The purposes of this study are (1) to examine characteristics associated with those willing and unwilling to receive a COVID-19 vaccine and (2) to illuminate the reasons behind their willingness and unwillingness to receive the vaccine using both quantitative and qualitative data. Data collected from 505 US working adults showed that several demographic variables (i.e. education, the size of their organization, the number of dependents, political orientation, and religion) and influence sources (i.e. family members, workplace leaders, political leaders, social media influencers, and healthcare workers) significantly correlated with people’s willingness/unwillingness to receive a COVID-19 vaccine. Furthermore, protecting oneself was the most common reason cited by participants for willingness to get the vaccine, while being concerned about vaccine side effects was the most frequently given reason for being unwilling to receive a COVID-19 vaccine. This study expands our current understanding of the COVID-19 vaccine motivators and intention factors. Practically, the findings can help develop health campaign messages effectively target working adults who are unwilling to receive the COVID-19 vaccines and ultimately increase the vaccination rate in the United States.

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### KEYWORDS

COVID-19 vaccine; vaccine intention; vaccine motivation; deterrents for COVID-19 vaccination

COVID-19 vaccines have been developed and administered in the United States since December 2020. However, despite the numerous reports about vaccine effectiveness in protecting against serious disease and death, the overall vaccination rate in the nation is below 68% for the fully vaccinated, and about 79% for those who have at least the first shot for vaccines requiring two doses.<sup>1</sup> Vaccine hesitancy remains a serious problem as more than 97% of people who end up hospitalized with COVID-19 have not been vaccinated.<sup>1</sup> This coronavirus and its mutations have shown that individual immunity achieved from infection or vaccination wanes over time, requiring periodic vaccine boosters.<sup>2</sup> The most recent Omicron variant of COVID-19 is highly contagious, spreading much more rapidly than any of the prior variants and creating surges of cases that once again overwhelmed hospitals and health care systems in some areas.<sup>3</sup> Clearly, the need for COVID-19 vaccines will persist for many years to come along with the need to address vaccine hesitancy.

Motivated by this ongoing public health threat, the current study examined motivations and intentions to get a COVID-19 vaccine, with the goal of understanding potential deterrents, motivators, and other correlates of vaccine intention. It is particularly important to understand and address vaccine hesitancy of working adults for several reasons. First, employees who work in person have a higher chance of COVID-19 exposure and infection, resulting in higher health risks for themselves and others with whom they have contact. Second, working adults have had to adapt in complex ways to COVID-19, which could influence their perceptions of

COVID-19 vaccines and their willingness to receive a vaccine. In fact, vaccine hesitancy persists in this population. Improved understanding of the specific reasons underlying individual or subgroup COVID-19 vaccine intention will inform more effective and targeted health messaging and interventions to encourage and achieve higher vaccination rates.

Several studies have examined underlying reasons for COVID-19 and general vaccine intention and hesitancy. Palamenghi et al.<sup>4</sup> found from Italians that willingness to get vaccines correlated positively with trust in research and vaccines, which decreased over their study period. The proportion of Italian citizens willing to get vaccinated was too small to stop the COVID-19 pandemic. Dube et al.<sup>5</sup> studied vaccine experts’ and front-line vaccine providers’ opinions of vaccine hesitancy in Canada. The “diffusion of negative information online and lack of knowledge about vaccines” were the key causes of vaccine hesitancy. The authors also suggested an improved understanding of vaccine intention and hesitancy would provide better guidance for interventions.

Scholars suggest vaccine intention is a multifaceted and dynamic social process reflecting various sources of influence, meaning, and logic.<sup>6</sup> Individuals’ perspectives and practices of vaccination involve ongoing engagement with their personal and social environments. For example, vaccine intention in higher-income countries like the US and Canada can be very different from that in African or South Asian countries.<sup>7</sup> Betsch et al.<sup>8</sup> proposed a 5C model of the drivers of vaccine intention based on their research in higher-income countries: Confidence, complacency, constraints, risk calculation, and

collective responsibility. Confidence is about trust in the effectiveness and safety of vaccines, the system administering vaccination, and the motivation of people. Complacency occurs when perceived risks of infectious diseases (e.g., SARS-CoV-2) are low, and vaccination is considered unnecessary. Constraints include structural or psychological barriers for people to convert their vaccination intention to actual behaviors, such as lack of health insurance or fear of needles. Risk calculation involves a “deliberate comparison of the risks of infection and vaccination” and the consequential decision of which poses a greater risk. Finally, collective responsibility relates to the willingness to protect others by one’s own vaccination in order to achieve herd immunity.

While there is extensive research on vaccine intention and hesitancy, certain features of the COVID-19 vaccines and the information ecosystem surrounding them have hampered vaccination. First, new vaccines in general generate more hesitancy.<sup>6</sup> Second, the fact that most COVID-19 vaccines were developed within a year or less and use new messenger RNA technology generated more doubt and anxiety among the public about the safety and effectiveness of these vaccines. Vaccine development for a new pathogen has traditionally taken years, if not decades.<sup>9</sup> Third, many COVID-19 vaccine antigen carrying platforms (e.g., mRNA, adenovirus carrier) have also never been used in humans prior to the COVID-19 vaccines, which also increased uncertainty about their safety and effectiveness. In the absence of clear communication about why these vaccines could be developed quickly, these concerns and uncertainties resulted in the public and some healthcare providers’ mistrust of scientists and government, exacerbating the problem of vaccine hesitancy.<sup>6</sup>

Psychological attributes also play a role in COVID-19 vaccine intentions. Using nationally representative samples of Ireland ( $N=1041$ ) and the United Kingdom ( $N=2025$ ), Murphy et al.<sup>10</sup> examined psychological characteristics associated with vaccine hesitancy. They found that while vaccine-resistant participants from the two countries varied in relation to their socio-economic, cultural, political, and geographical characteristics, both populations shared similar psychological profiles. Particularly, COVID-19 vaccine hesitant persons were more self-interested, more distrusting of experts and authority figures, more likely to hold strong religious beliefs as well as conspiratorial and paranoid beliefs compared to their vaccine accepting counterparts. They were also more likely to believe that their lives are mainly under their own control, to prefer societies that are hierarchically structured and authoritarian, and to be more intolerant of migrants in society. Vaccine resisting persons were also more impulsive in their cognitive style, and “had a personality characterized by being more disagreeable, more emotionally unstable, and less conscientious.”<sup>10(p9)</sup>

However, we still know very little about the specific motivations to get a COVID-19 vaccine or to avoid getting one and how these motivations align with other factors influencing vaccine intention. Bearing this limitation in mind, this study expands the current understanding of the relevant predictors of vaccine intentions and examines specific motivations behind COVID-19 vaccination to further understand people’s decision-making thought processes. Obviously, reducing vaccine

hesitancy is critical for the sake of one’s health but also public health. To that end, it is important to understand what factors contribute to people’s COVID-19 vaccine intention and specific reasons behind their intention or hesitancy, first. Therefore, we conducted this study to uncover whether any demographic groups, personality types, or influence sources are associated with COVID-19 vaccine intention and hesitancy.

In particular, we focused on people’s intentions given that intentions are important antecedents of actual behaviors.<sup>11</sup> Moreover, we believe that understanding people’s intentions related to COVID-19 vaccines will help effectively promote COVID-19 vaccines and increase vaccination rates. In the long term, it can also further expand our understanding of general vaccine hesitancy, and help pandemic preparedness. This study utilized both quantitative and qualitative approaches. Specifically, quantitative data were collected to identify the demographic, personality, and influence sources that are related to COVID-19 vaccination, while qualitative data were collected to reveal specific motivations and deterrents underlying willingness and unwillingness of COVID-19 vaccination. This mixed-method approach is beneficial for producing novel insights into why some people are more willing or less willing for vaccination.

General vaccine intention is often influenced by individual factors such as emotions, values, risk perceptions, knowledge, beliefs, as well as sociocultural, political, and historical factors.<sup>12</sup> With the importance of individual factors in mind, this study considers three main predictors of COVID-19 vaccine intentions (i.e., demographics, personality, and influence sources). First, previous studies have shown that some demographic groups have higher vaccine hesitancy than others.<sup>13</sup> Therefore, it is important to examine specific deterrents for these groups regarding COVID-19 vaccines. This study includes an expanded set of demographic variables beyond what previous studies have considered and investigates which demographic variables are related to COVID-19 vaccine intentions.

Second, we study the effects of personality, specifically positive affect, negative affect, and the big five factors (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness to new experiences). These personality variables have been studied with respect to a wide variety of attitudes and behaviors, including those relating to vaccines.<sup>10</sup> Positive trait affect reflects an enduring tendency to experience positive feeling states such as enthusiasm, while negative trait affect reflects a stable tendency to experience negative feeling states such as fear. Extraversion is defined as the extent to which individuals are active, energetic, enthusiastic, assertive, and dominant.<sup>14</sup> Agreeableness is characterized as trusting, altruistic, caring, and gullible.<sup>14,15</sup> Conscientiousness represents the characteristics of being persistent and motivated, and hard-working.<sup>16</sup> Neuroticism refers to an individual’s degree of anxiety, depression, impulsiveness, vulnerability, and hostility.<sup>14</sup> Finally, openness to experiences indicates people who seek new ideas and experiences and are highly curious.<sup>17</sup>

Individuals higher in trait-positive affect may generally feel more hopeful and positive about the benefits of the COVID-19 vaccines, whereas people higher in negative affect may be more sensitive to and fearful of the new vaccines, how well they work,

and their potential negative side effects. Regarding the big five factors, based on Murphy et al.,<sup>10</sup> we expect that agreeableness, conscientiousness, and neuroticism would significantly predict vaccine intention. Although Murphy et al.'s<sup>10</sup> study did not find the significant effects of extraversion and openness to new experiences, we suggest that extraversion and openness could play a role in COVID vaccine intention. Specifically, people who are extroverted like to go out and interact with others. Because COVID-19 vaccines offer protection from severe illness, extroverts who like to work and socialize in-person or who want to attend large gatherings or events, may be more likely to get a COVID-19 vaccine. People who are open to new experiences may be more likely to seek novel experiences, people, and places, and may have greater curiosity about the new COVID-19 vaccines, suggesting that those higher in openness are more willing to get the vaccine. Yet, it is unclear whether the same findings of Murphy et al. will hold in a US sample of working adults. We investigate the big-five personality dimensions in the current study, as well as trait positive and negative affect. Last, we focus on the effects of influence sources and examine how sources of COVID-19 vaccine-related information are related to COVID-19 vaccine intentions. This examination is important especially considering the information ecosystem of the new vaccines, which includes factual science-based communication as well as misinformation, disinformation, and everything in between.<sup>18</sup> In sum, this study proposes the following two research questions:

**RQ1.** What individual factors (e.g., demographics, personality, influence sources) are associated with willingness to receive a COVID-19 vaccine?

**RQ2.** What are the reasons people provide for their intention to receive or not receive a COVID-19 vaccine?

## Method

### Design and sample

We collected cross-sectional data from 505 participants via Amazon's Mechanical Turk (MTurk) between March 2nd and March 6th in 2021.<sup>a</sup> MTurk is an online platform that enables recruitment and hiring of people who are part of an online workforce or marketplace. Researchers are able to upload studies, indicating particular sampling criteria (e.g., working adults), estimated time the study will take and how much participants can earn by completing the study. MTurk samples are valid sources for research.<sup>19</sup> To ensure good data quality, we also followed Aguinis et al.'s<sup>20</sup> suggestions such as including attention check items, answering participants' inquiries as soon as possible, and monitoring MTurker discussion boards during the data collection. Eligibility requirements for this study included being 18 or older, living in the United States, and working at least 40 hours per week.

### Outcome measure

*Willingness (Unwillingness) to Receive a COVID-19 Vaccine.*<sup>b</sup> Participants were first asked whether they were willing to get

a COVID-19 vaccine. "Yes" was coded as 1 and "no" was coded as 0. Then, they were asked to describe why they were willing (or unwilling) to receive a COVID-19 vaccine with an open-ended question to better understand specific reasons behind their COVID-19 vaccine intentions. Note that we developed and used our own COVID-19 specific questionnaires rather than adopting existing general vaccine hesitancy scales because this COVID-19 pandemic situation and COVID-19 vaccines were unprecedented and unique.

### Predictor measures

#### Demographic variables

Various demographic and socio-demographic types of information were collected. This included participants' gender, age, race, level of education, the size of their organization, marital status, the number of dependents, working industry, political party affiliation, and religion. The gender question included two options: (1) men and (2) women. The age question was open-ended. The race variable had six options: (1) white, (2) black or African American, (3) American Indians or Alaska Native, (4) Asian, and (5) Native Hawaiian or Pacific Islander, and (6) others (with a text box). The level of education had nine options: (1) less than high school, (2) high-school graduate, (3) some college, (4) trade/technical/vocational training, (5) associate's degree, (6) bachelor's degree, (7) master's degree, (8) professional degree, and (9) doctorate. Organization size was coded as (1) small = 1–49 employees, (2) medium = 50–499 employees, and (3) large = 500 or more employees. The marital status variable was measured with two options: (1) married or living with a partner and (2) not living with a partner. The number of dependents was measured with six options: (1) none, (2) 1, (3) 2, (4) 3, (5) 4, and (6) 5 or more. The industry-type question had 29 options.<sup>c</sup> The political party affiliation question had five options: (1) Republican, (2) Democrat, (3) independent, (4) no preference, and (5) others (with a text box). Last, the religion question had nine options: (1) Christian/Protestant/Methodist/Lutheran/Baptist, (2) Catholic, (3) Mormon, (4) Buddhist, (5) Hindu, (6) Muslim, (7) Jewish, (8) nothing in particular, and (9) other religions. All categorical variables were dummy coded for the main analyses. Categories that included less than 25 cases (approximately less than 5% of the participants) were not included in further analyses to ensure sufficient power.

#### Personality variables

Participants also completed personality measures capturing trait-positive affect, trait-negative affect, extraversion, agreeableness, conscientiousness, neuroticism, and openness to new experiences. Specifically, positive affect and negative affect were measured with the Positive and Negative Affect Schedule (PANAS).<sup>21</sup> An example item for positive affect was "Inspired" while an example item for negative affect was "Upset." Participants answered the items based on a 5-point scale that ranged from 1 (*very slightly or not at all*) to 5 (*extremely*) in response to the prompt which asked "Read each item and indicate to what extent you feel this way *in general*." In addition, we used the scale developed by Rammstedt and John<sup>22</sup> to assess participants' big five personality traits (i.e., extraversion,



agreeableness, conscientiousness, neuroticism, and openness to new experiences). An example item for extraversion was “I am outgoing, sociable.” An example item for agreeableness was “I am considerate and kind to almost everyone.” An example item for conscientiousness was “I do a thorough job.” An example item for neuroticism was “I get nervous easily.” An example item for openness to new experiences was “I have an active imagination.” All the items were rated on a 5-point scale that ranged from 1 (*strongly disagree*) to 5 (*strongly agree*).

### **Influence sources**

We asked participants to indicate which groups influenced their COVID-19 vaccine-related decision. We provided the following group options: family members, friends, colleagues, workplace leaders, religious leaders, political leaders, celebrities, social media influencers, healthcare workers, strangers, and others. Participants evaluated whether each group influenced their COVID-19 vaccine-related decision with a 5-point scale that ranged from 1 (*not at all*) to 5 (*totally*).

### **Data analyses**

In order to answer RQ1, we performed a multivariate logistic regressions using SPSS version 27, specifying participants' willingness to receive a COVID-19 vaccine (Yes or No) as a dependent variable and entering demographic variables as predictors. To test RQ2 and gain a more nuanced understanding of why people were willing (or unwilling) to receive a COVID-19 vaccine, the open-ended qualitative question was content-coded using a grounded theory of constant comparison method.<sup>23</sup> The data coding was performed by three independent coders who earned a Ph.D. degree in a related research area.

First, the three coders independently reviewed 80 responses (40 responses of participants who were willing to get a COVID-19 vaccine and 40 responses of participants who were unwilling to get a COVID-19 vaccine) and generated their own codes for each group. Then, the three coders met, discussed, and developed a comprehensive coding scheme for each group. To minimize coding inconsistencies between coders and increase coding accuracy, the three coders independently coded 100 identical responses (50 responses of participants who were willing to get a COVID-19 vaccine and 50 responses of unwilling). Later, the coders met again and compared their coding. Although most coding was consistent, some minor discrepancies were found, which were resolved through group discussions. Also, the three coders added several coding options to the existing coding scheme as those new options were not discovered in the preliminary coding. Finally, the coders split the remaining responses and coded them with a clear understanding of coding rules and a finalized coding scheme.

## **Results**

### **Participants**

To ensure data quality, we included three attention check items. Data from 40 participants who failed to select a correct response on an attention check were removed, resulting in 505

working adults' responses. Of the 505 working adults, 70.4% were white, the mean age was 37.54 years ( $SD = 10.30$ ), and 46.3% were women. Regarding participants' level of education, 3.6% had a high school degree, 11.1% took some college credits but did not graduate, 1.6% had trade/technical/vocational training, 5.3% had an associate degree, 50.9% had a bachelor's degree, 24.4% had a master's degree, 1.8% had a professional degree, and 1.4% had a doctorate degree. Participants worked in a variety of industries, such as finance and insurance (14.9%), information services and data processing (12.1%), and health care and social assistance (10.9%).

### **Descriptive statistics**

Table 1 shows means, standard deviations, and correlations among non-categorical predictors and willingness to be vaccinated. For the correlation analysis, zero-order Pearson correlations with a two-tailed approach were selected by default. Results showed the expected patterns of relationships among the personality variables, with trait-positive affect showing positive correlations with extraversion and agreeableness but a negative relationship with neuroticism. Negative affect was negatively correlated with agreeableness and conscientiousness and positively correlated with neuroticism. Personality variables did not have significant correlations with willingness to be vaccinated in this sample. The extent of influence on participants' vaccine decisions by influence sources likely to have closer and more trusted relationships with a participant (e.g., family members, healthcare workers) had larger correlations with vaccine intentions than influence from influence sources more distal to participants (e.g., celebrities, strangers). We found that 372 out of 488 responses (76.2%) indicated that they were willing to receive a COVID-19 vaccine and 116 out of 488 responses (23.8%) were hesitant to receive a COVID-19 vaccine. Of the 372 participants who were willing to receive the vaccine, 69.6% were white, the mean age was 37.70 years ( $SD = 10.51$ ), and 45.7% were women. Regarding their level of education (willing to receive the vaccine), 3.8% had a high-school degree, 8.9% took some college credits but did not graduate, 1.1% had trade/technical/vocational training, 5.4% had an associate degree, 50.0% had a bachelor's degree, 26.6% had a master's degree, 2.4% had a professional degree, and 1.9% had a doctorate degree. Participants who were willing to get vaccinated worked in a variety of industries, such as finance and insurance (14.5%), information services and data processing (12.1%), and health care and social assistance (10.5%).

On the other hand, of the 116 employees who were hesitant to receive a COVID-19 vaccine, 73.3% were white, the mean age was 36.66 years ( $SD = 9.64$ ), and 47.4% were women. Regarding their level of education, 3.4% had a high school degree, 18.1% took some college credits but did not graduate, 2.6% had trade/technical/vocational training, 5.2% had an associate degree, 50.9% had a bachelor's degree, 19.8% had a master's degree, 0% had a professional degree, and 0% had a doctorate degree. These participants also worked in a variety of industries, such as finance and insurance (17.2%), health care and social assistance (12.9%), and information services and data processing (10.3%).

Table 1. Means, standard deviations, and correlations.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
<i>Demographics</i>																							
1. Gender <sup>a</sup>	0.46	0.5																					
2. Age	37.54	10.3	-.01																				
3. Number of dependents	1.94	1.2	-.05	.04																			
<i>Personality</i>																							
4. Positive affect	3.22	0.95	-.09*	.13**	.25**																		
5. Negative affect	1.97	1.06	-.06	-.15**	.30**	.17**																	
6. Extraversion	2.83	1.04	-.08	.05	.03	.31**	-.09*																
7. Agreeableness	3.66	0.84	-.04	.14**	-.10*	.37**	-.35**	.26**															
8. Conscientiousness	3.96	0.93	.10*	.19**	-.18**	.07	-.59**	.18**	.40**														
9. Neuroticism	2.61	1.11	.19**	-.22**	.03	-.28**	.45**	-.34**	-.45**	-.38**													
10. Openness	3.47	0.93	.06	.02	-.16**	.05	-.22**	.16**	.20**	.23**	-.14**												
<i>Sources of Influence</i>																							
11. Family members	3.11	1.38	-.05	.09	.12*	.33**	.15**	.11*	.17**	0.01	-.04	-.03											
12. Friends	2.85	1.32	-.07	-.04	.10*	.29**	.28**	.09*	.12**	-.10*	.03	-.04	.69**										
13. Colleagues	2.64	1.37	-.05	-.03	.17**	.33**	.34**	.10*	.07	-.17**	.04	-.07	.55**	.70**									
14. Workplace leaders	2.44	1.35	-.09*	-.03	.18**	.36**	.38**	.10*	.04	-.23**	.03	-.06	.48**	.59**	.76**								
15. Religious leaders	2.07	1.36	-.17**	-.04	.34**	.33**	.52**	.05	-.09*	-.34**	.07	-.18**	.29**	.39**	.51**	.62**							
16. Political leaders	2.17	1.34	-.12**	-.09	.26**	.35**	.53**	.05	-.08	-.33**	.10*	-.12**	.34**	.45**	.49**	.58**	.72**						
17. Celebrities	1.89	1.25	-.16**	-.08	.36**	.35**	.58**	.08	-.16**	-.40**	.13**	-.17**	.28**	.37**	.50**	.56**	.78**	.74**					
18. Social media influencers	1.89	1.29	-.14**	-.09	.35**	.34**	.61**	.10*	-.17**	-.41**	.10*	-.19**	.27**	.37**	.48**	.56**	.72**	.86**					
19. Healthcare workers	3.27	1.39	-.01	.04	.00	.23**	.16**	.10*	.13**	.02	-.01	.06	.37**	.39**	.41**	.36**	.23**	.34**	.28**	.26**			
20. Strangers	1.93	1.26	-.14**	-.10*	.29**	.31**	.55**	.11*	-.14**	-.36**	.08	-.16**	.28**	.43**	.51**	.59**	.67**	.68**	.73**	.72**	.27**		
21. Others	1.94	1.44	-.06	.01	.14**	.12*	.33**	-.05	-.08	-.18**	.08	-.15**	0.04	.11*	.19**	.22**	.29**	.29**	.32**	.35**	.16**	.37**	
22. Vaccine willingness	0.76	0.43	-.02	.04	-.12**	.05	-.05	.00	.13	.01	-.01	.07	.24**	.19**	.19**	.16**	.00	.11*	.00	-.02	.33**	.01	.02

N = 505.

<sup>a</sup>Female = 1, Male = 0.\* $p < .05$ , \*\* $p < .01$ .

## Logistic regressions

First, we conducted a multivariate logistic regression analysis with all of the demographic and socio-demographic variables as predictors (see Table 2). The overall model was significant ( $Chi-Square = 54.17$ ,  $p < .001$ ) with demographic variables accounting for 13% of the variance in vaccine willingness ( $Cox \& Snell R^2 = .13$ ). With respect to the continuous demographic predictors, results showed that participants with higher levels of education ( $B = .27$ ,  $p < .01$ ), who worked in larger organizations ( $B = .49$ ,  $p < .01$ ) and had fewer dependents ( $B = -.23$ ,  $p < .01$ ) were significantly more willing to receive a COVID-19 vaccine. Categorical predictors of political orientation and religion were also significantly related to vaccine willingness. Relative to Republicans, Democrats and Independents were 3.04 and 2.35 times more willing to receive a COVID-19 vaccine, highlighting the politicized nature of vaccine willingness in this sample. Relative to Christians, participants grouped into the other religions category were 2.02 times more willing to receive a COVID-19 vaccine. Gender, age, race, marital status, and industry type were not significantly associated with vaccine willingness.

Second, we examined the effects of personality variables on people's COVID-19 vaccine intentions (see Table 3). Initially, when positive affect, negative affect and the big five personality variables were simultaneously entered as predictors, the overall model was not significant. Positive and negative affect share some construct overlap with the big five personality variables

(e.g., PA is positively related to agreeableness and extraversion, while NA is negatively related to conscientiousness and agreeableness) potentially suppressing the effects of personality on vaccine willingness. When the model was run with only the big five personality variables, the overall model was significant ( $Chi-square = 11.62$ ,  $p < .05$ ) with personality accounting for a small amount of variance (2%) in vaccine willingness ( $Cox \& Snell R^2 = .02$ ). Agreeableness was the only significant personality variable associated with vaccine willingness ( $B = .45$ ,  $p < .01$ ) such that participants higher in agreeableness were more willing to receive COVID-19 vaccines.

Last, we examined the relationship of various groups influencing participants COVID-19 vaccine decision-making (see Table 4). The overall model for sources of influence was significant ( $Chi-square = 77.03$ ) accounting for 17% of the variance in vaccine willingness ( $Cox \& Snell R^2 = .17$ ). Results revealed that family members ( $B = .30$ ,  $p < .05$ ), workplace leaders ( $B = .37$ ,  $p < .05$ ), political leaders ( $B = .46$ ,  $p < .05$ ), social media influencers ( $B = -.42$ ,  $p < .05$ ), and healthcare workers ( $B = .49$ ,  $p < .05$ ) significantly affected people's willingness to receive a COVID-19 vaccine. Specifically, participants who rated family members, workplace leaders, political leaders, and healthcare workers as more influential in their vaccine decision-making were more willing to receive a COVID-19 vaccine. Interestingly, participants who rated social media influencers as more influential in their vaccine decision-making were less willing to receive a COVID-19 vaccine.

**Table 2.** Multiple logistic regression showing demographic variables relationships with willingness to receive a COVID-19 vaccine.

	<i>B</i>	<i>Exp(B)</i> Odds ratio (95% CI)	<i>p</i> -value
Gender (male = 0, female = 1)	.31		.25
Age	.02		.27
Race			.47
White (reference group)	–	–	–
Black	–	1.54 (.74–3.22)	.25
Asian	–	.89 (.37–2.14)	.79
Education level	.27		.00**
Organizational size	.49		.01**
Married	.22		.51
Number of dependents	–.23		.05*
Industry Type			.25
Service (reference group)	–	–	–
Technology	–	1.66 (.91–3.00)	.10
Operations & manufacturing	–	1.19 (.60–2.39)	.61
Political orientation			.00**
Republican (reference group)	–	–	–
Democrat	–	3.04 (1.71–5.41)	.00**
Independent	–	2.35 (1.10–5.00)	.03*
Religion			.08
Christian (reference group)	–	–	–
Catholic	–	1.00 (.55–1.84)	.99
Other religions	–	2.02 (1.05–3.89)	.03*

*N* = 505. \* $p < .05$ . \*\* $p < .01$ . No control variables were included.

**Table 3.** The effects of big five personality variables on willingness to receive a COVID-19 vaccine.

Personality Variables	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>Exp(B)</i>
Extraversion	–.06	.11	.28	.94
Agreeableness	.45**	.15	9.08	1.57
Conscientiousness	–.12	.13	.88	.88
Neuroticism	.08	.12	.52	1.09
Openness to new experiences	.15	.12	1.62	1.17

*N* = 505. \*\* $p < .01$ . No control variables were included.

**Table 4.** The effects of influence sources on willingness to receive a COVID-19 vaccine.

Influence Sources	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>Exp(B)</i>
Family members	.30*	.14	4.91	1.35
Friends	-.07	.16	.20	.93
Colleagues	.20	.17	.46	1.22
Workplace leaders	.37*	.18	4.08	1.44
Religious leaders	-.33	.18	3.49	.72
Political leaders	.46**	.20	5.51	1.58
Celebrities	-.15	.23	.42	.86
Social media influencers	-.42*	.21	3.84	.66
Healthcare workers	.49**	.11	20.13	1.63
Strangers	-.30	.18	2.70	.74
Others	.04	0.10	.14	1.04

*N* = 505. \**p* < .05. \*\**p* < .01. No control variables were included.

### Qualitative data analyses

Outcomes of the rationale or motivations provided by participants for why they were willing or unwilling to receive a vaccine are presented in Table 5. Out of 327 participants willing to get a vaccine, 133 participants (40.67%) provided more than one reason. Out of 161 participants not willing to get a vaccine, 13 participants (8.07%) provided more than one reason. Results revealed a variety of common reasons why people were willing to receive a COVID-19 vaccine. The top reasons included (in rank order of frequency): 1) to protect themselves, 2) belief that the vaccines are safe and effective, 3) to protect others, 4) to facilitate a return to normal life, 5) to end the pandemic, and 6) because it's the right thing to do. The most salient reasons why people were unwilling to receive a COVID-19 vaccine included: 1) worry over possible side effects of the COVID-19 vaccines, 2) lack of research on long term effects of the vaccines, 3) concern that vaccine development was rushed, 4) anti-vaccine sentiments, including a belief in misinformation about vaccines, and 5) the fact that COVID-19 has a high recovery rate. It is notable that many of the reasons for being unwilling to get a COVID-19 vaccine contain misinformation.

### Discussion

The current study utilized both quantitative and qualitative approaches to understand factors influencing un/willingness to receive COVID-19 vaccines and reasons for such un/willingness. We found that several key demographic factors accounted for significant variance in vaccine willingness, including education, organization size, number of dependents, political orientation and religion. Participants who were less educated, worked for smaller organizations, had a larger number of dependents, Republicans, and Christians were less willing to receive a COVID vaccine. Additionally, while being more agreeable accounted for a small amount of variance in vaccine willingness, influence sources appeared to be the most important variables in this study, accounting for 17% of the variance in vaccine willingness. Specifically, when family members, workplace leaders, political leaders, and healthcare workers were seen as influencing participant's vaccine decision-making, participants were more willing to receive a COVID-19 vaccine, whereas those who were influenced by social media influencers were less willing. Through analyzing participants' written responses of reasons for un/willingness, the study found concerns about possible side effects, safety of vaccines, and lack of research evidence due to rushed development were

**Table 5.** Reasons behind people's willingness/unwillingness to get a COVID-19 vaccine.

Willing to get a COVID-19 Vaccine (N = 327)		Unwilling to get a COVID-19 Vaccine (N = 161)	
Reasons provided	Frequencies	Reasons provided	Frequencies
To protect myself	207	Side effects concerns/safety concerns/adverse effect concerns	28
The vaccines are effective and safe; I understand the science behind COVID-19 vaccines	104	Lack of research evidence (Unknown long-term effects)	21
To protect others	100	Rushed vaccine development	15
To go back to normal (e.g., travel, dining out)	37	No specific reasons	13
No specific reasons	33	Anti-vaccines (Strong belief in their health and natural recovery; e.g., autism)	10
To end the pandemic and reduce the spread of COVID-19	31	COVID has a high recovery rate (don't see it as a high-risk virus)	8
It is the right thing to do	21	History of having adverse reactions to vaccines	6
I will be getting one, but I am still worried about potential safety issues	9	Belief in vaccine ineffectiveness (e.g., due to COVID mutations)	5
To socialize with others	7	Undecided/unsure	5
Undecided/unsure	7	Others (not relevant)	4
Don't want to worry	7	I am a healthy person and don't need a vaccine.	4
For work	7	Lack of trust in the pharmaceutical industry	2
To help boost economy for society	5	I am pregnant	2
Others (not relevant)	3	I am worried about unexpected insurance costs	1
Because I trust experts	3	I am concerned about complex views and conflicting information	1
To follow government rules	2	I don't accept that policy (mistakenly thinking that vaccine is mandated)	1



the most common reasons for vaccine hesitancy. Overall, the majority of the sample (over 75%) were willing to receive vaccines, and the reasons for the willingness were protection for self and others, confidence in vaccine safety and effectiveness, and desire to end the pandemic and go back to normal.

Combining the results of logistic regression and analyses of qualitative data, the level of education seems to play important roles in vaccine hesitancy. Specifically, logistic regression results showed that the level of education positively predicted people's willingness to receive a COVID-19 vaccine. In other words, people who reported higher levels of education were more willing to get vaccinated and endorsed vaccine safety and effectiveness more strongly. On the other hand, people who reported lower levels of education were less willing to get vaccinated and endorsed vaccine safety and effectiveness less strongly. This result resonated with a number of previous studies; for example, Kricorian et al.<sup>24</sup> found from their national survey people in the US who believed COVID-19 vaccines were unsafe knew less about the vaccine and were less educated. Khairat et al.<sup>24</sup> also identified from their county-level data analysis that lack of high school education was a major predictor of vaccine hesitancy and low vaccination in the US. However, contradictory findings exist that vaccine hesitancy was not consistently linked to the education level of mothers in five low- to mid-income countries in Wagner et al.<sup>25</sup> Nevertheless, Wagner et al.<sup>25</sup> neither focused on COVID-19 vaccines nor the US population. Another study based on German secondary school students showed that children under the age of 16 and those with lower parental education reported higher vaccine hesitancy.<sup>26</sup>

These research findings suggest we need more public education about the safety and effectiveness of vaccines as people with lower education did not seem to have enough opportunities to learn the science behind vaccines and be reinforced in their knowledge and positive attitude toward vaccination. In addition to education provided through public school systems, the government and public health officials need a wider-ranging approach reaching out to these groups who lack knowledge and trust in vaccine science. Individual level of education itself is not easily modifiable; thus, policymakers can focus their efforts on closing the knowledge gaps in perceiving effectiveness and safety of COVID-19 vaccines via more targeted interventions.<sup>24</sup>

The finding of participants being more willing to get vaccinated if they work in organizations of larger sizes makes sense. People working in larger organizations are at higher risk of exposure to COVID-19 given more frequent opportunities of interactions with others; thus, they might be more willing to get vaccinated. Additionally, some large organizations strongly encouraged and in some cases signaled that they would require employees to get vaccinated against COVID-19 (e.g., CVS, Goldman Sachs, Facebook). However, it was unexpected that people with more dependents living in the same households were less willing to be vaccinated. Although dependents are not necessarily just children, the fact that children of 12 years or younger could not get vaccinated at the time of data collection might be related to the participants' un/willingness. They

might have thought even if they were vaccinated, they were still exposed to the virus due to their children being unvaccinated; or those who have many dependents in our sample happened to be people who are more concerned about potential side effects of vaccination. It may be that parents or caregivers of younger children are more influenced by outdated and debunked vaccine misinformation (e.g., linking vaccines to autism) which is still prevalent in anti-vaxxer public discourse.<sup>18</sup> Furthermore, results showed that Republicans and Christians were less willing to get a COVID-19 vaccine. Both of these factors may be related to the broader politicization of the COVID-19 vaccines which emerged just after a contentious presidential election in the U.S. The former president who lost the election routinely spread misinformation about COVID-19 in public statements online and offline.<sup>27</sup> We encourage future researchers to collect qualitative data on these socio-demographic variables to delve deeper into the driving reasons these factors are related to vaccine hesitancy.

In terms of personality variables, results revealed that more agreeable people were more willing to get a COVID-19 vaccine. These findings resonated with Murphy et al.'s<sup>10</sup> from Ireland and UK that vaccine hesitant and resisting individuals were disagreeable in their personality characteristics. However, unlike Murphy et al.'s<sup>10</sup> study, our research did not show significant effects of neuroticism and conscientiousness on people's vaccine intention. We speculate that the discrepant results stemmed from the different sample sizes between Murphy et al.<sup>10</sup> and the current study. Note that Murphy et al. included 1041 Ireland residents and 2025 UK residents, while the current study included 505 US working adults. The large sample size in the former study perhaps provided additional power which led to detecting significant effects of neuroticism and conscientiousness.

It is also noteworthy that while many influence sources such as family members, workplace and political leaders, and healthcare workers played positive roles in encouraging vaccine willingness, social media influencers had a negative influence according to our analysis. While this finding confirms the trend Murphy et al.<sup>10</sup> found from their Irish and English samples, it also resonates with another study that analyzed COVID-19 health communication networks on Twitter.<sup>28</sup> By applying social network analysis, Kim and Valente<sup>28</sup> analyzed a massive amount of Twitter mentions and retweets related to COVID-19 information flow and identified diffusion and transmission of information was not effective; rather than public health professionals and media specialists, nonprofessionals (e.g., social media influencers) were more heavily involved in Twitter communication about COVID-19, which could lower the credibility and accuracy of information circulated in the social media space. The more frequently participants of this study used social media influencers as their influence sources for the pandemic, the more hesitant they were in receiving vaccines as they might have been exposed to more mis/disinformation about COVID-19 vaccines while following and communicating with social media influencers.

## Implications

Findings of this study have several implications for public health practices including vaccine promotion and health messaging campaigns. As the study identified protection of self and others, and belief in vaccine safety and effectiveness as the most common reasons for willingness of vaccination, public health professionals, media specialists, community leaders, and government officials could use such information to promote vaccination further related to the current COVID-19 pandemic and any future similar incidence of public health crisis. More importantly, health messaging campaigns might be developed to address concerns of those who are less willing to get vaccinated. Messages could explain the procedure of COVID-19 vaccine development including how the method was innovative, based on decades of existing research, and funded immensely by the government and pharmaceutical industry due to the urgency of the matter. The key is to facilitate more trust in science and medicine among those who are less willing and let them think the unknown risk of vaccination might be as dangerous, if not more, as the unknown long-term side effects of COVID infection. One of the major reasons for this long battle with the pandemic has to do with the virus mutation and low vaccination rates, which slow down or prevent societies from achieving herd immunity. If unvaccinated people realize they can potentially harm themselves and others by spreading a virus that is much more transmissible and dangerous than any regular flu or other similar types of virus, they may become more willing to get vaccinated.

However, beyond improving, increasing, and tailoring education and messaging regarding the science of vaccines, there is also a need to address the influence of political leaders on public health. There are likely unmeasured variables driving this association which may need to be addressed in future research such as politicians' communication and messaging about the vaccines as well as how COVID-19 vaccines have been discussed among the various types of influence and news sources used by members of various political parties.

The findings of the current study provide some direction and focus for more effective intervention as public health professionals and the government may tailor health campaigns more acceptable to populations with lower education level, working at small or midsize organizations, who have many dependents at the household, and of Republicans and Christian religious identification.<sup>29</sup> We also recommend that fact-checking and correcting misinformation both with social and algorithm-based approaches on social media should be utilized more actively as the finding suggests those relying on social media influencers as the influence sources of vaccine-related decisions were much more hesitant to get vaccinated potentially due to their exposure to mis- and disinformation.<sup>30,31</sup>

## Limitations and future research

This study has several limitations. First, we wanted to perform supplemental analyses to further understand how the demographic and individual characteristic variables intersected with specific motivations, intentions, and hesitations. However, the

number of participants was not sufficient for these supplemental analyses. We encourage future researchers to collect additional data with more participants and further examine who are likely to report the specific motivations, intentions, and hesitations found in this study. In addition, data were collected in March 2021 when not all individuals in the U.S. were eligible to get a COVID-19 vaccine. This factor might have influenced people's willingness to get a COVID-19 vaccine. Longitudinal data collection should take place in order to understand how vaccine availability plays a role in people's willingness and unwillingness to get a COVID-19 vaccine.

The current study used MTurk data to investigate our research questions. Although using MTurk data may hinder our ability to generalize the findings to a broader US population, we followed Aguinis et al.'s<sup>20</sup> suggestions to ensure good MTurk data quality such as including attention check items. Moreover, we offered only two options (1 = Yes, 0 = No) to measure people's willingness (unwillingness) to receive a COVID-19 vaccine. However, it is also possible that some people might have a neutral opinion or no opinion at all on receiving a COVID-19 vaccine and feel forced to endorse a dichotomous option. We recommend future researchers consider vaccine intention as a continuum and also include "no opinion" as an additional option to measure COVID-19 vaccine intentions. Finally, we used open-ended questions in a survey format to understand the reasons behind people's willingness (or unwillingness) to get a COVID-19 vaccine. Although we carefully developed the open-ended questionnaires based on collective efforts by experts in various fields, it could be possible that the questions did not measure exactly what they meant to measure. Thus, we encourage future researchers to test the validity of the questions. Also, to obtain richer information on the reasons behind people's willingness to get a COVID-19 vaccine, we recommend future researchers conduct in-depth interviews and examine why certain individuals are more willing (or unwilling) to get a COVID-19 vaccine.

In terms of future research, we suggest collecting and comparing cross-national data to compare whether the reasons for willingness (or unwillingness) to get a COVID-19 vaccine are similar or different across countries. This information may enable more effective strategies to reduce vaccine hesitancy and increase the COVID-19 vaccination rates in various countries. Such research is important given globalization and the interconnected nature of countries across the world, all of which are experiencing various levels of COVID-19 spread and vaccine hesitancy. While our study with a US sample identified about 25% resistance, Murphy et al.<sup>10</sup> found over 30% of hesitancy among Irish and UK respondents.

In addition, future researchers should consider developing and implementing effective health messages and examining how those messages change vaccine hesitancy at the individual level and vaccine uptake at the national level, if at all. For example, as concern for safety and side effects is the most common reason why people are unwilling to get vaccinated, researchers may want to develop health campaign messages that are meant to reduce such particular concern for safety and side effects. This type of research is likely to yield positive practical outcomes such as increasing COVID-19 vaccination rates and help the society fight against this global crisis.

## Conclusion

This study illuminates the demographic, personal, and motivational factors influencing willingness (or unwillingness) to receive a COVID-19 vaccine using both quantitative and qualitative data. Results reveal that people who are less educated, work in a smaller organization, have more dependents, identified as Republicans, reported as Christians, less agreeable and more affected by social media influencers are more unwilling and hesitant to receive a COVID-19 vaccine. In addition, the most common motivations behind people's willingness to get a COVID-19 vaccine are to protect themselves, a belief in the vaccine safety, and a desire to protect others, while the most salient motivations behind their unwillingness to get a COVID-19 vaccine are worry over possible side effects, lack of research on long term vaccine effects, and that vaccine development was rushed, despite the vast resources and use of techniques that had been studied for more than a decade. This study sheds light on COVID-19 vaccine motivators, intentions, and hesitancy factors, and potentially helps develop health campaign messages for targeting those who are unwilling to receive the COVID-19 vaccines.

## Notes

- [a] Note that COVID-19 vaccines started being administered from December 2020. In March 2021 when this data was collected, 280 out of 488 participants (57.4%) indicated that they were eligible to get a COVID-19 vaccine.
- [b] At the time of data collection (in March 2021), COVID-19 vaccines were not available for everyone. Therefore, we measured people's willingness (unwillingness) to receive a COVID-19 vaccine instead of measuring whether they actually received a COVID-19 vaccine.
- [c] For the main analysis, we regrouped the industry options into the four categories: (1) service industries, (2) education, science & tech industries, (3) administrative & management industries, and (4) operations & manufacturing industries.

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