The Role of Personality and Experience in Vaccine Hesitancy and Harm Concern

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Abstract

This research study is an exploratory analysis of the role of vaccine experiences and personality in vaccine hesitancy and vaccine harm concern. Two hundred and thirty-one participants were recruited from Amazon Mechanical Turk and compensated for completing the survey. The results indicated positive correlations between all personality measures (conspiracist ideation, neuroticism, extraversion, schizotypy, paranoia, probabilities and coincidences, and attitudes towards science) and belief measures (vaccine harm concern and vaccine hesitancy). There was also a significant positive correlation between the types of negative vaccine experiences (personal, close others, story, and social media) and the personality and belief measures. The results demonstrate that a negative experience with vaccines is associated with a higher amount of vaccine hesitancy and harm concern.

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Introduction

Vaccine development is often cited as one of the most important achievements of public health (Larson et al., 2014). In recent years, however, the rate of vaccination has decreased in many regions of the world (Jolley & Douglas, 2014). According to the TN Department of Health's 2020 Immunization Status Survey, there was a decrease of up to 26% in immunizations between 2019 and 2020. Further, the TN Department of Health reported that in 2020, there will be more incomplete immunization records than in the previous three years. One of the primary reasons for the decline in vaccinations is an increase in the tendency of individuals to be resistant to vaccines, or vaccine hesitant. Vaccine hesitancy is defined as "the delay in acceptance or refusal of vaccination despite availability of vaccination services" (MacDonald, 2015, p. 4163). Vaccine hesitancy is "complex and context specific, varying across time, place, and vaccines" (MacDonald, 2015, p. 4163). Peretti-Watel et al. (2015) have criticized the ambiguity of the available definitions and have theorized that vaccine hesitancy is a decision-making process that depends on one's level of commitment to health culture as well as one's confidence in health authorities and mainstream medicine. To gain a better understanding of vaccine hesitancy, one must understand the people who display it and the experiences that influence their belief.

Dube et al. (2013), in their paper providing an overview of vaccine hesitancy, described the attitudes toward vaccination as a continuum with active demand for vaccines at one end of the spectrum to complete refusal of vaccines at the other end. Vaccine hesitant individuals are a heterogenous group in the middle of the continuum

who may display traits from both ends of the spectrum (Dube et al., 2013). Additionally, Dube et al. (2013) examined many factors that are playing a key role in the increase of vaccine hesitancy in the developed world. The factors consisted of media and communication, public health and vaccine policies, health professionals, the individual decision making process, knowledge and information about vaccines, past experiences with vaccination services, perceptions of the importance of vaccination in maintaining health, health professionals' recommendations and use of complementary and alternative medicine (CAM), risk perceptions, trust in health professionals, social pressure and social responsibility, and moral or religious convictions. For the purposes of this study, past experiences with vaccination services were one of the key factors that informed our results.

Based on the strong evidence supporting the positive impact that vaccination has on public health, vaccine hesitancy is considered by some as pseudoscience. Shermer (1997) defines pseudoscience as "claims presented so that they appear scientific even though they lack supporting evidence and plausibility" (p. 1). Tseng et al. (2014) proposed personal experience, close others' experiences, storytelling, and television as sources of pseudoscientific belief. Their study examined the relationship between majoring in science and holding pseudoscientific beliefs as well as the extent of the relationship between television exposure and pseudoscientific beliefs among students majoring in science to find out whether majoring in science had a moderating effect on the relationship. Their results indicated that the higher the exposure of students to pseudoscientific television programs, the more likely they were to believe and engage in

pseudoscience. They also confirmed the moderating effect of majoring in science (Tseng et al., 2014). If vaccine hesitancy is considered a pseudoscience, then these results are applicable to belief in vaccine hesitancy.

Paterson et al. (2016) examined the effect of vaccine confidence on vaccine intentions. They looked at the influence of vaccine confidence and vaccine behavior of healthcare providers on vaccination recommendations to others based on a meta-analysis of 185 other reviews. Their results indicated that overall knowledge about vaccine's efficacy and safety helped to build confidence in vaccines and increased willingness to recommend vaccines to others (Paterson et al., 2016).

Jolley & Douglas (2014) performed two studies in which they looked at the effect of anti-vaccine conspiracy beliefs on vaccine intentions. Conspiracist ideation is associated with a mistrust in science such as climate change denial and other scientific propositions such as the link between smoking and lung cancer (Lewandowsky et al., 2013). The results of the two studies show that exposure to anti-vaccine conspiracy theories directly affects vaccination intentions and that the effects are significantly mediated by the perceived dangers of vaccines (Jolley & Douglas, 2014). Hartman et al. (2017) found that people's beliefs about the benefits of vaccination or risks of a disease can predict people's vaccination behavior. In their research, they developed the Credibility of Science Scale (CoSS), which is a six-item measure that can be used to predict beliefs across a wide range of contemporary science topics.

Understanding the roots of vaccine hesitancy might help with the design of interventions to address it. The current state of the intervention literature is that

interventions are rarely effective due to the complex nature of the underlying relationships between personality, experience, and vaccine hesitancy. Kaufman et al. (2018) examined the effect of face-to-face interventions for informing and educating parents about early childhood vaccination. The results were inconsistent and ranged from no effect at all to significant increase in vaccination. Odone et al. (2015) examined the effectiveness of new media, such as text messaging, smart phone applications, YouTube videos, Facebook, and e-mail communication to improve vaccine acceptance. The findings were inconsistent across platforms with text messaging increasing vaccine acceptance and social media, e-mail communication, and smart phone applications showing no effect. Sadaf et al. (2013) looked at thirty studies that measured parental vaccine refusal behavior and the attitudes toward immunization and intent to vaccinate and applied interventions to decrease parental refusal of and hesitancy toward recommended childhood and adolescent vaccines. Most of the examined studies used a before and after intervention design and the review did not reveal any convincing evidence on effective interventions to address parental vaccine hesitancy and refusal. Williams (2014) reviewed the known barriers to vaccination reported by vaccine hesitant parents and the current evidence on strategies to address parental vaccine hesitancy. They looked at 15 studies that measured vaccine attitudes and vaccine intent. The data indicated that there are no interventions that have a superior effect over others and that the decision-making process is complex and influenced by factors that are difficult to measure, such as influence by social networks. They concluded that this complexity most likely contributes to the lack of evidence for effective interventions (Williams, 2014).

Nyhan et al. (2014) tried to change belief by assigning participants to one of four intervention groups. The first group was given information explaining the lack of evidence that MMR causes autism from the Centers for Disease Control and Prevention. The second group was given textual information about the dangers of diseases prevented by MMR from the Vaccine Information Statement. The third group was shown images of children who have diseases prevented by the MMR vaccine, and the fourth group was given a dramatic narrative about an infant who almost died of measles from a Center for Disease Control and Prevention fact sheet. None of the interventions increased intent to vaccinate a future child, indicating that further studies of pro-vaccine messaging were needed to determine a proper intervention method. Due to the lack of evidence supporting an effective intervention method, the present study will not attempt to change belief. The proposal is that more effective interventions can come from a better understanding of the type of people who are more likely to display vaccine hesitancy. To determine who shows vaccine hesitancy, it is important to be able to measure vaccine hesitancy first accurately and reliably.

Martin & Petrie (2017) developed the Vaccination Attitudes Examination (VAX) scale and attempted to establish its reliability and validity across two studies. The scale measures attitudes toward vaccines, prior and expected future vaccine behavior, perceived sensitivity to medicines, online behavior, and demographics. The results of the two studies found four distinct but correlated vaccine attitudes: mistrust of vaccine benefits, worries about unforeseen future effects, concerns about commercial profiteering, and preference for natural immunity (Martin & Petrie, 2017). Larson et al. (2015) developed a survey to measure vaccine hesitancy that will be used in the current

study. Larson et al. (2015) concluded that the scope of the survey is limited due to the term "vaccine hesitancy" being new and the need for more information regarding who displays vaccine hesitancy, what their concerns are, and where they are located. The purpose of the present study will be to gain more information regarding who displays vaccine hesitancy by looking at several different personality variables.

Conspiracist ideation refers to alternate explanations as to why a specific event occurred. It is hypothesized that those who display higher vaccine hesitancy and harm concern will have higher conspiracist ideation scores than those who display lower vaccine hesitancy and harm concern.

The "Big Five" is a personality measure that measures five different personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Lobato et al. (2014) found that extraversion and neuroticism were significant predictors of epistemically unwarranted beliefs. They also found moderate to strong positive correlations between the three categories of epistemically unwarranted beliefs (paranormal, conspiracy, and pseudoscience), which suggests that believers in one type tend to also endorse other types (Lobato et al., 2014). Based on prior research, it is hypothesized that those who are highly vaccine hesitant and show higher harm concern will be more extraverted and neurotic than those who are lower in vaccine hesitancy.

Schizotypy is associated with schizophrenia and is characterized by disturbed thoughts and behavior, unusual beliefs and fears, and difficulty forming and maintaining personal relationships. Kelley (2011) found that schizotypy is related to some aspects of paranormal belief. Since paranormal beliefs fall into the category of epistemically

unwarranted beliefs and believers in one type of epistemically unwarranted belief tend to also endorse other types (Lobato et al., 2014), it is hypothesized that those with higher vaccine hesitancy and harm concern scores will show higher levels of positive, negative, and disorganized schizotypy than those with low vaccine hesitancy.

Paranoid individuals often exhibit high levels of suspicion and believe that someone is conspiring against them. These individuals often have false ideas about people and events happening in the world (Freeman et al., 2005) The present study is measuring paranoia because participant suspicion is an important influence on the results that the research may yield. Therefore, the present study hypothesizes that someone who scores high in vaccine hesitancy and harm concern will display more paranoia than someone who is low in vaccine hesitancy.

Bressan (2002) conducted a study in which believers in the paranormal reported more coincidences in their daily lives than non-believers. Believers also made more errors than non-believers in tasks reflecting sensitivity to the relationship between expected distribution of chance events and total number of occurrences, indicating a propensity of believers in the paranormal to connect separate events. It is hypothesized that those with higher levels of vaccine hesitancy will report more coincidences and a higher likelihood of connecting separate events than those without vaccine hesitancy.

To recap, I expect that vaccine-hesitant individuals will be higher on conspiracist ideation, extraversion and neuroticism from the Big Five, schizotypy, paranoia, probabilities and coincidences, and attitudes towards science than individuals who are not vaccine hesitant.

Methodology

Participants

Two hundred and fifty-nine participants completed the survey. Participant age ranged from 19 to 63 years (M = 34.54, SD = 8.71). Participants were 70.6% men and 29.4% women. Participants were originally recruited through social media and blogs (e.g., Vaccine Education Network: Natural Health Anti-vaxx Community, Vax vs Anti-Vax, and Vaccine Talk: A Forum for both Pro and Anti-Vaxxers) that discussed vaccines (Appendix C). After a low response rate using these methods, the remainder of the participants were recruited through Amazon Mechanical Turk. An addendum was submitted and approved by the IRB to authorize this change in methodology (Appendix F). Twenty-eight participants indicated in the survey that they did not try very hard and were thus removed from all analyses, making the total number of participants 231.

Materials

Experience measures. First, the present study measured whether the individual had experienced a harmful side effect because of vaccination. The participant then chose the harmful experiences that the affected individual experienced from the same list of side effects as shown in the previous paragraph regarding personal experience. They were asked to respond using a Likert scale (1 = *strongly disagree* to 5 = *strongly agree*) to fear items: “I do not want an experience like this to happen again; This experience was scary” “Thinking about experiences like this frightens me,” “This experience was very important to me” and “I would be afraid to have an experience like this happen again (these items were derived from the Anomalous Experiences Inventory (Gallagher, Kumar, & Pekala,

1994). The measures in this inventory demonstrate good internal reliability (α = .73). The participant was then asked to rate the intensity of the experience on the same scale by rating the items: “This experience was intense,” “This experience is familiar to me (compared to things I have heard from others, TV, movies, etc.),” “I can form a clear mental image of this experience,” “This experience was concrete (as opposed to abstract),” and “The experience was vivid”. Again, these intensity measures demonstrated high internal validity (α = .78).

The participant was then asked to indicate if they have a close personal other who had a negative vaccine experience. If they reported that they did, they were prompted with follow-up questions (e.g., “Did this event happen to the person you know themselves or did they witness it?”). The relationship between the individual completing the survey and the person who had the negative vaccine experience was also requested (e.g., immediate family member, close relative, distant relative, close friend, distant friend, acquaintance, co-worker or other). The participant was then asked questions related to how they thought the person who had the negative experience felt during the situation by completing the positive and negative affect scale (PANAS) (Watson, Clark, & Tellegen, 1988). The participant was then asked to answer the same fear and intensity questions from when they were asked about their personal experience (α = .79 and .81, respectively). Lastly, the participants were asked to evaluate the credibility of the source from which they heard about the negative experience and whether it seemed to have happened to them (Appendix A). If the participant reported that they heard stories about vaccine harm, they were asked the same questions except for the PANAS.

The final set of vaccine experience questions were regarding media exposure. Participants were asked "Do you belong to any Facebook, Twitter, or other social media groups that present information about or discussions of vaccines (e.g., Vaccine Education Network: Natural Health Anti-vaxx Community, Vax vs Anti-Vax, and Vaccine Talk: A Forum for both Pro and Anti-Vaxxers)?" Participants were also asked to indicate how many hours a day/week they spend on these social media sites. They were then asked if they follow any celebrities who are prominent anti-vaccine supporters. Some examples of prominent anti-vaccine celebrities include Jenny McCarthy, Alicia Silverstone, Billy Corgan, and Charlie Sheen. Participants were then asked if they regularly watched any anti-vaccine movies, television programs, or talk shows that may influence their beliefs. Lastly, participants were asked to select which (if any) of the following blogs they have visited from the following list: Vox, Shot of Prevention, The Vaccine Blog by Karen Ernst, The History of Vaccines.org, Think Twice: Global Vaccine Institute, or other (please explain). With each question regarding celebrities, television, social media, and blog sites, participants were asked to estimate how much time was spent daily and weekly on each. If participants reported yes to any of the binary questions, they were then prompted to report how many they follow, and to rank them on a Likert-scale (1= *far below average* to 7= *far above average*) on level of knowledge, competence, intelligence, credibility, and expertise (Appendix A).

Belief measures. The vaccine belief measures were taken from Larson et al. (2015). Two aspects of belief were measured: Vaccine harm concern and vaccine hesitancy.

For vaccine harm concern, participants were provided with four statements and were asked to rate these statements on a Likert scale (1= *strongly disagree* to 5= *strongly agree*). An example statement is: "Vaccines have been linked to autism." This measure had excellent internal reliability (α = .84).

For vaccine hesitancy, the hesitancy scale from Larson et al. (2015) was used. The participant was asked to rate ten statements on a Likert scale (1= *strongly disagree* to 5= *strongly agree*). Example statements include "Vaccines are effective," "New vaccines carry more risks than older vaccines," and "Generally, I do what my doctor or healthcare provider recommends about vaccines." This measure had good internal reliability (α = .76). Items 5, 9, and 10 on the vaccine hesitancy scale were reverse-coded.

Personality measures. Conspiracist ideation was measured with the Belief in Conspiracy Theories Inventory (BCTI) (Appendix A). The BCTI is a fifteen-item scale in which participants rate a series of statements from 1 (*completely false*) to 9 (*completely true*). Example statements included "US agencies intentionally created the AIDS epidemic and administered it to Black and gay men in the 1970s," and "The Apollo moon landings never happened and were staged in a Hollywood film studio" (Swami et al., 2014; α = .97).

The "Big Five" factors of personality were measured by using the twenty-item mini-International Personality Item Pool (mini-IPIP) (Donnellan et al., 2006). Participants were asked to rank the how accurately each statement described them from 1 (*inaccurate*) to 5 (*very accurate*). The five subscales consisted of: (1) extraversion (E; "Am the life of the party"; α = .58), (2) agreeableness (A; "Sympathize with others'

feelings"; α = .55), (3) conscientiousness (C; "Get chores done right away"; α = .34), (4) neuroticism (N; "Have frequent mood swings"; α = .37) and (5) intellect/imagination (I; "Have a vivid imagination"; α = .68). Items 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, and 20 were reverse-coded.

Schizotypy was measured by using Gross et al.'s (2018) thirty-eight item Multidimensional Schizotypy Scale-Brief (MSS-B) measure (Appendix A). Participants were asked to rate each item as either "true" or "false". There were three subscales consisting of: (1) positive schizotypy (P; I have sometimes felt that strangers were reading my mind; α = .88) (2) negative schizotypy (N; Throughout my life I have noticed that I rarely feel strong positive or negative emotions; α = .69), and (3) disorganized schizotypy (D; "My thoughts and behaviors are almost always disorganized"; (α = .88).

Paranoia was measured by using the eighteen-item Paranoia Checklist (Freeman et al., 2005). Participants were asked to rate each item based on how strongly they believed each statement to be true or false. Participants chose their rating from five options ranging from 1 (*do not believe it*) to 5 (*absolutely believe it*). Sample items consisted of "Someone I know has bad intentions toward me" and "I can detect coded messages about me in the press/TV/radio" (α = .98).

Probabilities and coincidences were measured by using the eight-item Questionnaire on Coincidences (Bressan, 2002). Participants were asked to rate each item on a 5-point Likert scale (1 = *never* to 5= *very often*) based on how often they have experienced coincidences falling in each of the provided categories. Sample categories consisted of "Series or clusters of names, numbers, or events of the same kind (like

coming repeatedly across a word, never heard before, in the space of a few hours)", "Perception of something distant in space (like worrying about a person at the exact same time in which that person is having an accident)" and "Unexpected solution of a problem (like meeting a friend who wants to sell his computer exactly when we were looking for one)" ($\alpha = .91$).

Attitudes towards science were measured using Hartman et al.'s (2017) six-item Credibility of Science Scale (CoSS) (Appendix A). Participants were asked to rate each item on a 7-point Likert scale (1= *disagree very strongly* to 7= *agree very strongly*). Sample items included "People trust scientists a lot more than they should," and "Sometimes I think we put too much faith in science." This measure also had excellent internal reliability, $\alpha = .94$.

Demographics. Lastly, participants were asked to provide demographic information including age, sex, level of education, religiosity, and income level (Appendix A).

Procedure

After extensive research, it was determined that the following Facebook groups and blog websites would be best to reach out to because people who interact on these blogs and Facebook pages are the most likely to fit the targeted demographic of vaccine-hesitant individuals: Voices for Vaccines, Think Love Healthy, March Against Monsanto, J.B. Handley, Erin at Health Nut News, and the International Revolution for Choice. After a low response rate from these groups, the survey was posted to Facebook for anybody to complete. After another low response rate, it was decided that participants

would be recruited through Amazon Mechanical Turk and compensated for their time. An IRB addendum was submitted to approve this change to the procedure (Appendix F). Participants were compensated $1.50 for their participation.

Participants began the survey by providing their informed consent (Appendix D) and ensuring that they were at least eighteen years of age. From there, participants completed the survey by reporting their experiences with vaccines, levels of vaccine hesitancy and harm concern, and the personality variables. After completing this part of the survey, participants reported demographics and were asked if they put their best effort in to completing the survey.

Results

Survey responses were collected in two rounds between November 2020 and April 2021. Due to a low response rate to the first round of data collection, the researcher made an amendment to IRB protocol in April 2021 to use Amazon Mechanical Turk to increase the response rate (Appendix F). Of the 259 participants in the study, 231 were included in all analyses. Participants were eliminated if they answered that they did not try very hard at the end of the survey. See Tables 1, 2, and 3 for descriptive statistics of experience variables, belief variables, and personality variables, respectively. It was hypothesized that there would be significant positive correlations between all personality measures (conspiracist ideation, neuroticism, extraversion, schizotypy, paranoia, probabilities and coincidences, and attitudes towards science) and the belief (vaccine harm concern and vaccine hesitancy) and experience (personal, close other's, story, and media) measure.

Table 1

Descriptive Statistics for Experience Variables

Variable	*N*	Minimum	Maximum	*M*	*SD*
Age	230	19	63	34.53	8.710
First-Hand Personal Experience	164	0	100	4.60	9.930
Second-Hand Personal Experience	163	0	33	3.36	3.840
Personal Compelling Events	166	1	7	2.07	1.210
Fear	166	7	25	18.60	3.670
Intensity	166	6	25	18.80	3.700
Others' Compelling Events	118	1	8	2.27	1.330
Others' Fear	118	7	25	19.31	3.900
Others' Intensity	117	7	25	19.31	3.840
Internalization of Others' Experience	118	1	5	3.93	0.922
Story Compelling Events	139	1	6	2.18	1.217
Story Fear	139	6	25	19.09	3.782
Story Intensity	139	11	25	19.10	3.322
Story Internalization	139	1	5	3.87	0.908
Social Media Credibility	121	5	35	25.87	5.574
Celebrity Credibility	94	8	35	26.29	5.303
YouTube Credibility	102	8	35	26.47	5.018

Note. Higher means reflect higher reporting of that measure.

Table 2

Descriptive Statistics for Personality Variables

Variable	*N*	Minimum	Maximum	*M*	*SD*
Positive Schizotypy	231	0	13	5.96	4.157
Negative Schizotypy	231	0	12	5.90	2.949
Disorganized Schizotypy	231	0	12	5.78	3.944
Conspiracist Ideation	231	15	135	80.43	33.428
Coincidences Overview	231	1	5	3.37	0.986
Coincidence Types	231	7	35	21.31	6.986
Extraversion	231	4	20	11.58	3.271
Agreeableness	231	4	20	12.99	3.031
Conscientiousness	231	5	20	12.68	2.766
Neuroticism	231	4	20	11.36	2.920
Intuition	231	4	20	12.38	3.549
Paranoia	231	18	90	52.60	20.663

Note. Higher means reflect higher reporting of that measure.

Note. Minimum and maximum values are indicative of the minimum and maximum reported values for the data set.

Table 3

Descriptive Statistics for Belief Variables

Variable	*N*	Minimum	Maximum	*M*	*SD*
Belief Concern	231	1	5	2.94	1.286
Belief Harm	231	3	15	9.64	3.420
Attitude Towards Science	231	6	42	26.89	9.914
Belief Hesitancy	231	10	50	35.69	6.129

Note. Higher means reflect higher reporting of that measure.

Experience and Belief

A Pearson's *r* test was performed for the correlational analyses (Table 4). As expected, there were significant positive correlations between experience and belief. There were significant positive correlations between personal, close others, and story experiences and vaccine harm concern. There were many significant negative correlations for vaccine hesitancy, but this is because higher scores on the vaccine hesitancy scale represented lower vaccine hesitancy. Therefore, it indicates greater vaccine hesitancy is positively associated with personal, close others, and story experiences. For media experiences (social media, celebrity, and YouTube), there were only significant positive correlations between these experiences and vaccine harm concern, but no statistically significant correlations with vaccine hesitancy except for YouTube. This indicates that media experience may be a less important factor when looking at vaccine hesitancy. The exception of YouTube is likely related to perceived

credibility as many in the younger generations use YouTube as their primary news source.

Table 4

Experience and Belief Correlations

Variable	Vaccine Harm	Vaccine Hesitancy
Personal Experience	.43 **	-.42 **
Close Others' Experience	.36 **	-.14 *
Story	.35 **	-.17 **
Social Media	.34 **	-0.02
Celebrity	0.15	.21 *
YouTube	.29 **	.37 **

*$p < .05$, ** $p < .001$.

Note. Higher scores on the vaccine hesitancy scale represent lower vaccine hesitancy.

Experience and Personality

As hypothesized, there were significant positive correlations (Table 5) between the types of negative vaccine experience and the six personality variables (conspiracist ideation, neuroticism, extraversion, schizotypy, paranoia, probabilities and coincidences, and attitudes towards science). There were significant positive correlations between personal experience and all six personality variables. For close others' experience, there were significant positive correlations between these and all the personality variables except for attitudes towards science and extraversion from the Big Five. Story experiences had significant positive correlations with all personality variables except for

extraversion. For the types of media experiences, social media experience had significant positive correlations with all personality variables except for negative schizotypy, extraversion, and neuroticism. Celebrity experience had significant positive correlations with all variables except for attitudes towards science, disorganized schizotypy, conspiracist ideation, neuroticism, and paranoia. Finally, YouTube experience had significant positive correlations with all variables except for negative schizotypy, extraversion, and neuroticism.

Personality and Belief

As expected, there were significant positive correlations between personality variables and the belief measures (Table 6). There were significant positive correlations between vaccine harm concern and all six personality variables. The data showed significant negative correlations between vaccine hesitancy and all six personality variables, but this is because the vaccine hesitancy scale is reversed with higher scores representing lower vaccine hesitancy. This means that higher levels of personality variables are correlated with higher vaccine hesitancy which aligns with vaccine harm correlation and confirms our hypothesis.

Table 5

Experience and Personality Correlations

Variable	ATS	PS	NS	DS	CI	P&C	E	N	P
PE	.60 *	.67 **	.47 **	.58 **	.70 **	.73 **	.25 **	.20 **	.75 **
COE	.36	.41 **	.30 **	.36 **	.39 **	.37 **	.11	.15 *	.40 **
Story	.31 **	.31 **	.20 **	.26 **	.31 **	.41 **	.08	.17 *	.32 **
Social Media	.31 **	.33 **	.04	.31 **	.34 **	.34 **	.15	-.07	.39 **
Celebrity	.15	.21 *	.22 *	.14	.18	.31 **	-.26 **	.06	.18
YouTube	.29 **	.37 **	0.14	.35 **	.30 **	.34 **	0.1	.03	.41 **

*$p < .05$, ** $p < .001$.

Note. The following variables are abbreviated: PE= personal experience, COE= close others' experience, ATS= attitudes towards science, PS= positive schizotypy, NS= negative schizotypy, DS= disorganized schizotypy, CI= conspiracist ideation, P&C= probabilities and coincidences, E= extraversion, N= neuroticism, and P= paranoia.

Table 6

Personality and Belief Correlations

Variable	Vaccine Harm	Vaccine Hesitancy
Attitudes Towards Science	.77 **	-.51 **
Positive Schizotypy	.60 **	-.36 **
Negative Schizotypy	.46 **	-.46 **
Disorganized Schizotypy	.54 **	-.39 **
Conspiracist Ideation	.76 **	-.45 **
Probabilities & Coincidences	.71 **	-.32 **
Extraversion	.18 **	-.13 **
Neuroticism	.16 **	-.19 **
Paranoia	.75 **	-.39 **

*$p < .05$, ** $p < .001$.

Note. The vaccine hesitancy scale is reverse-coded.

Discussion

The results of the current study indicate that there are relationships between personality, experience, and vaccine hesitancy. More specifically, the results show that a negative experience with vaccines is associated with a higher amount of vaccine hesitancy and harm concern. Also, a higher amount of vaccine hesitancy and harm concern is associated with higher scores on the personality variables that were being measured: conspiracist ideation, neuroticism, extraversion, schizotypy, paranoia, probabilities and coincidences, and attitudes towards science.

By far the most significant findings were between personality characteristics and vaccine harm. There were four significant predictive relationships between personality

measures and vaccine harm belief: attitudes towards science, conspiracist ideation, probabilities and coincidences, and paranoia. The strongest predictive relationship (*r*= .77) was between attitudes towards science and vaccine harm. Those who had more negative attitudes towards science were more likely to believe that vaccines cause harm.

The items regarding attitudes towards science examined how much people trust scientists, lack of faith in scientific research, and the amount of influence that scientists have in society, among others. With the prevalence of Dr. Fauci during the pandemic, this could have had a significant impact on people's beliefs regarding scientists and scientific findings in general (Ponnuru, 2021). With the coronavirus pandemic being a novel virus that scientists were actively trying to contain, they were learning new things about it every day. Therefore, Dr. Fauci was often giving conflicting advice in rapid succession which caused people to doubt his claims and wonder whether he truly knew what the right answer was. Therefore, the widespread media attention to the ever-evolving science surrounding coronavirus could have contributed to these attitudes towards science (Ponnuru, 2021).

Conspiracist ideation had a strong predictive relationship (*r*= .76) with vaccine harm. During the pandemic, people were stuck in their homes. This led to a significant increase in the amount of social media consumption. Depending on where participants were consuming media, they may have been more apt to consume high levels of media related to conspiracy theories. Many conspiracy theories during this time were related to coronavirus being a hoax, a tool of government control, and a way to microchip citizens. Again, with so much conflicting information and so many unknowns, people were more

likely to place their belief in some of these theories which increased their belief that vaccines could be harmful to them.

There was a strong predictive relationship (r= .75) between paranoia and vaccine harm. People with paranoia are inclined to catastrophize and believe that the worst will happen despite any evidence of positive outcomes or a lack of credible evidence that proves negative outcomes will occur. As noted in the DSM V, they can be subject to persecutory delusions which are categorized as false and inflexible beliefs that others are engaging in a plan or plot to harm them (American Psychiatric Association, 2022). Therefore, those who are high in paranoia were more likely to believe harm would occur due to their skepticism and skewed beliefs towards pessimismplat.

Finally, there was a strong predictive relationship (r= .71) between a higher number of coincidences reported and beliefs in vaccine harm. There was a positive relationship between those who reported a higher number of coincidences and those who were high in conspiracist ideation (r= .76). This belief in coincidences and the willingness to see patterns where there may not be any makes someone more susceptible to accept alternative theories behind vaccine harm when the events they are observing could be just random or due to chance.

The results of the current study support the findings of Dube et al. (2013) that personal experiences play a role in the development of vaccine hesitancy. In all analyses, personal experience had the strongest relationship with vaccine harm concern and vaccine hesitancy compared with the other types of experiences (close others', storytelling, social media, celebrities, YouTube). In other words, those who had a

negative experience with vaccines reported a higher level of vaccine harm concern and vaccine hesitancy. This does not mean, however, that other types of experience did not matter. In fact, there were significant positive correlations between each of the types of experience, which indicates, for example, that someone who has had a personal experience with vaccines has also had a close other have a negative experience with vaccines or has heard a story detailing a negative vaccine experience.

Tseng et al. (2014) found that personal experience, close other's experiences, storytelling, and television are sources of pseudoscientific belief. The present results are generally consistent with Tseng's findings. The three types of media exposure measured all showed positive correlations with vaccine harm concern but no correlations with vaccine hesitancy. This implies that the media sources are not providing proper education about vaccines because they are making people focus on all the negative aspects of vaccines and using fear as a tactic to make people develop concerns that vaccines are harmful. Vaccine hesitancy indicates that a person is undecided about whether vaccines are harmful or beneficial. If the media were truly providing a balanced perspective on vaccines, we should not see any associations between vaccine harm concern and the amount of media exposure (Wawrzuta et al., 2021). The results of the current study indicate that this is true for the types of media examined for this research.

It is important to note the context within which this study occurred. On March 11, 2020, the coronavirus was declared a global pandemic. In December 2020, the media announced that multiple vaccines had passed clinical trials and were due to roll out soon. The first round of data collection occurred prior to the official vaccine roll out. Vaccines

became available to the public in March 2020. Therefore, with the timing of the second round of data collection, it is possible that vaccine hesitancy was increased as people were actively being vaccinated and information regarding the vaccines was more in the public eye.

Future research should be directed toward the role of intellect/imagination (or openness) in vaccine hesitancy. The present research only focused on extraversion and neuroticism from the Big Five since it was found to be associated with the formation of epistemically unwarranted beliefs (Lobato et al., 2014).

However, intellect/imagination showed significant strong negative correlations with vaccine harm concern and all the personality measures as well as a positive correlation with vaccine hesitancy, the only personality variable to have this type of association with vaccine hesitancy. Therefore, because the vaccine hesitancy scale was reverse scored, those that scored high in intellect/imagination displayed lower vaccine hesitancy. Intellect/imagination was also the only variable to show a negative correlation with attitudes towards science. There was an interesting demographic trend that those who were higher in intellect/imagination were lower in religiosity. This is something that future studies could study as a potential confounding variable. Future research could also examine how other key demographic factors like race, age, and socioeconomic status affected vaccine attitudes to see if there are any significant differences or trends among groups.

Future research should also consider using the Vaccination Attitudes Examination (VAX) scale from Martin and Petrie (2017). This scale measures attitudes towards

vaccines, prior and expected future vaccine behavior, perceived sensitivity to medicines, online behavior, and demographics. It would be interesting to see how these factors contribute to the results of the present research. The vaccine hesitancy scale that ended up being used for this study is potentially a limitation because Larson et al. (2015) concluded that the scope of the survey is limited due to the lack of understanding of vaccine hesitancy at that time. Therefore, the VAX scale may be a better alternative for future research.

These results indicate that intellect/imagination play a larger role in the eventual acceptance of vaccines as well as more favorable attitudes towards science. Future research could examine the role of intellect/imagination in belief change. In other words, future research could measure vaccine acceptance and rejection and attempt to change belief from rejection to acceptance. Previous research has shown that belief is difficult to change (Nyhan, et al., 2014) but based on the results of the current study, intellect/imagination could be a factor in the eventual change of belief. It is important to note, however, that correlation does not imply causation and more experimental studies would need to be completed to determine how big of a role intellect/imagination plays in the role of vaccine hesitancy and harm concern.

The current study has several limitations. First, 63.6% of the sample was White so it is not representative of the global population. Although the sample was representative of the U.S. population, which according to the 2020 census is 62% White, the global population is 60% Asian. There are also concerns regarding the level of effort put in by participants. When examining the time spent taking the survey, the minimum duration in

seconds was 129 seconds (2.15 minutes) and the maximum was 3730 seconds (62.17 minutes) resulting in an average of 777.82 seconds (12.96 minutes). Those who spent the longest amount of time participating in the survey, may have experienced fatigue and lost accuracy in their responses towards the end of the survey, which could have made the results less reflective of the participants' actual beliefs. Of the 260 participants, only 53 invested more than 15 minutes in taking the survey which would be an adequate amount of time to be thoughtful about each item.

Additionally, a measure was included in the current study that measured the amount of effort put in by the participants when answering the questions in the survey. Out of the 259 participants, 28 participants reported that they did not try very hard when taking the survey. This could be because most of the sample was collected through Amazon Mechanical Turk. If the sample had come from vaccine blogs or vaccine groups on social media as originally intended, we may have seen less instances of this because people on the vaccine blogs are passionate about vaccines and would have tried harder when completing the survey.

The controversy surrounding the COVID-19 vaccine makes the current study that much more important. It is more crucial than ever in our society to learn more about people's attitudes towards vaccines and why they may be vaccine hesitant or concerned about vaccine harm. In the event of future pandemics, we have the potential to mitigate the harm and significantly decrease the duration of pandemics when we holistically understand people's aversion to vaccines and how to mitigate them.

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Appendix A: Survey

Please enter your age:

I have read the information above. I am at least 18 years old. I believe I understand the purpose, risks, and benefits of the research, and I know what I will be expected to do.

- I consent to participate
- I decline to participate

Measuring experience

Personal vaccine experience

Have you personally witnessed or experienced a situation where a person had an adverse reaction close in time with receiving a vaccination (think of any type of harm including development of autism)?

- Definitely not
- Probably not
- Might or might not
- Probably yes
- Definitely yes

For anything but definitely not:

How many of these reactions have you personally experienced?

How many of these reactions have you personally witnessed?

For the next set of questions, please answer based on the most compelling event you have experienced or witnessed.

Was the event you're thinking of something you experienced or witnessed?

- This event happened to me personally (experienced)
- This event was something I personally witnessed)

Still thinking of your most compelling event, check each of the following that was a part of it:

- Seizures (jerking or staring)
- Fainting
- High fever
- Soreness
- Fatigue
- Redness
- Itching
- Infection at the injection site
- Encephalitis (severe brain reaction)
- Something else (describe briefly)

Still thinking of your most compelling event: (matrix with the same 5 scale points for all statements below)

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree

Fear items:

- I do not want an experience like this to happen again.
- This experience was scary.
- Thinking about experiences like this frightens me.
- This experience was very important to me.
- I would be afraid to have an experience like this happen again.

Quality items:

- This experience was intense.

- This experience is familiar to me (compared to things I have heard from others, TV, movies, etc.).
- I can form a clear mental image of this experience.
- This experience was concrete (as opposed to abstract).
- This experience was vivid.

Other people's vaccine experience

Has someone in your social circle told you about a time they personally experienced or witnessed an adverse reaction close in time with someone receiving a vaccination (think of any type of harm including development of autism)? (A close other is someone like a family member, friend, or co-worker)

- No
- Yes

For yes:

For the questions below, please answer based on the most compelling event you have been told about by a person who experienced or witnessed it.

Did this event happen to that person themselves, or did they witness it?

- This event happened to them personally (experienced)
- This event was something they personally witnessed

Who told you about this event?

- Immediate family member
- Close relative
- Distant relative
- Close friend
- Distant friend
- Acquaintance
- Co-worker

If none of the above describe that person, please enter a description of the person who told you about their event:

Still thinking of this person's most compelling event, check each of the following that was a part of it:

- Seizures (jerking or staring)
- Fainting
- High fever
- Soreness
- Fatigue
- Redness
- Itching
- Infection at the injection site
- Encephalitis (severe brain reaction)
- Something else (describe briefly)

Still thinking of the same person's experience that has been told directly to you, choose answers below to describe how you think the person who experienced it felt about it.

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer next to that word. Again, this is how the person felt when they had the experience:

1. Very slightly or not at all
2. A little
3. Moderately
4. Quite a bit
5. Extremely

- Interested
- Distressed
- Excited
- Upset

- Strong
- Guilty
- Scared
- Hostile
- Enthusiastic
- Proud
- Irritable
- Alert
- Ashamed
- Inspired
- Nervous
- Determined
- Attentive
- Jittery
- Active
- Afraid

Still thinking of the same person's experience that has been told directly to you, think about YOUR personal reaction to hearing about this experience:

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree

Fear items:

- I would not want an experience like this to happen to me.
- Hearing about this experience was scary.
- Thinking about experiences like this frightens me.

- Hearing about this experience was very important to me.
- I would be afraid to have this experience happen to me.

Quality items:

- This experience was intense.
- This experience is familiar to me (compared to things I have heard from others, TV, movies, etc.).
- I can form a clear mental image of this experience.
- This experience was concrete (as opposed to abstract).
- This experience was vivid.

Still thinking of the same person's experience that has been told directly to you:

This experience feels as though it happened to me.

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree

Source credibility (individual)

Still thinking about the same person's experience that has been told directly to you, and thinking about the person who told you about this experience:

Please indicate your impression of that person by choosing the appropriate number between the pairs of adjectives below. The closer the number is to an adjective, the more certain you are of your evaluation.

Story vaccine experiences

Do you spend time with people in your social network sharing stories about vaccines and people's experiences with them (not personal experiences that happened to you or people in your social network, but stories that you have heard or read)? ("People in your social network" are people like family, friends, co-workers, or acquaintances)

- No
- Yes

For yes:

About how often do you share these stories with people in your social network?

- More than once per week
- At least once per week
- At least once per month
- At least once per year
- Less than once per year

For the next set of questions, please answer based on the most compelling vaccine event story you have heard.

Thinking of this most compelling vaccine event story, check each of the following that was a part of it:

- Seizures (jerking or staring)
- Fainting
- High fever
- Soreness
- Fatigue
- Redness

- Itching
- Infection at the injection site
- Encephalitis (severe brain reaction)
- Something else (describe briefly)

Still thinking of the same vaccine event story, think about YOUR personal reaction to the experience in this story:

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree

Fear items:

- I would not want an experience like this to happen to me.
- Hearing about this experience was scary.
- Thinking about experiences like this frightens me.
- Hearing about this experience was very important to me.
- I would be afraid to have this experience happen to me.

Quality items:

- This experience was intense.
- This experience is familiar to me (compared to things I have heard from others, TV, movies, etc.).
- I can form a clear mental image of this experience.
- This experience was concrete (as opposed to abstract).
- This experience was vivid.

Still thinking of the same vaccine event story:

This experience feels as though it happened to me.

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree

Social Media/Media

Do you follow or belong to any Facebook, twitter, or other social media groups or blogs, websites, or forums that present information about or discussions of vaccines (some examples include Vaccine Education Network: Natural Health Anti-vaxx Community, Vax vs Anti-Vax, Vaccine Talk: A Forum for both Pro and Anti Vaxxers, or any similar sites)?

- No
- Yes

For yes:

Please estimate how much time you spend in these types of groups or sites on the typical day.

- Less than one hour per day
- One to two hours per day
- Two to three hours per day
- Three to four hours per day
- More than four hours per day

Thinking about all of the vaccine-related social media sources you might view, please rate them (and the people producing them) on the following items:

1. Far below average
2. Moderately below average
3. Slightly below average
4. Average
5. Slightly above average
6. Moderately above average
7. Far above average

- Level of knowledge
- Competence
- Intelligence
- Credibility
- Expertise

Do you follow any celebrities who routinely discuss vaccine issues (for example, Jenny McCarthy, Alicia Silverstone, Billy Corgan, Charlie Sheen, or anyone similar)?

- No
- Yes

For yes:

Please estimate how many of these you follow.

- One to two
- Three to four
- Five to six

- Seven to eight
- More than eight

Thinking about all of the vaccine-relevant celebrities you follow, please rate them on the following items:

1. Far below average
2. Moderately below average
3. Slightly below average
4. Average
5. Slightly above average
6. Moderately above average
7. Far above average

- Level of knowledge
- Competence
- Intelligence
- Credibility
- Expertise

Do you watch any YouTube or other internet channels dealing with vaccines or vaccine-related issues (e.g., Vaxxed TV, or something similar)?

- No
- Yes

For yes:

Please estimate how much time you spend watching these types of channels on the typical day.

- Less than one hour per day
- One to two hours per day
- Two to three hours per day
- Three to four hours per day
- More than four hours per day

Thinking about all of the vaccine-related channels you might view, please rate them (and the people producing them) on the following items:

1. Far below average
2. Moderately below average
3. Slightly below average
4. Average
5. Slightly above average
6. Moderately above average
7. Far above average

- Level of knowledge
- Competence
- Intelligence
- Credibility
- Expertise

Belief

Beliefs Concern

What is your overall level of concern about adverse effects from vaccines?

- Not at all concerned
- A little concerned

- Somewhat concerned
- Moderately concerned
- Very concerned

How much do you agree with each of the following statements on vaccinations?

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

- Vaccines have been linked to autism.
- Vaccines have been linked to short term physical harm.
- Vaccines have been linked to long term physical harm.

Attitude towards science

Now you will be presented with a series of statements about scientists and the scientific community. Please indicate how well each statement describes your own views—that is, how strongly you disagree or agree with each statement.

Note that these statements deliberately focus on your general impressions about today's scientific community, its methods, and its conclusions. Further, note that some of the items may seem repetitive or redundant. This is intentional. Even if a statement seems very similar to a previous item, please take the time to rate each item on its own terms:

1. Disagree very strongly
2. Disagree strongly
3. Disagree somewhat

4. Neither agree nor disagree
5. Agree somewhat
6. Agree strongly
7. Agree very strongly

- People trust scientists a lot more than they should.
- People don't realize just how flawed a lot of scientific research really is.
- A lot of scientific theories are dead wrong.
- Sometimes I think we put too much faith in science.
- Our society places too much emphasis on science.
- I am concerned by the amount of influence that scientists have in society.

Hesitancy scale

How much do you agree with each of the following statements on vaccinations?

1. Strongly disagree
2. Disagree
3. Neither agree nor disagree
4. Agree
5. Strongly agree

- Vaccines are important for people's health
- Vaccines are effective
- Being vaccinated is important for the health of others in my community
- All vaccines offered in my community are beneficial
- New vaccines carry more risks than older vaccines
- The information I receive about vaccines from the medical community is reliable and trustworthy

- Getting vaccines is a good way to protect people from disease
- Generally, I do what my doctor or health care provider recommends about vaccines
- I am concerned about the serious adverse effects of vaccines
- People do not need vaccines for diseases that are not common anymore

MSS-B

Please answer true or false to the following items: (Matrix with the same 2 scale points for all statements below)

1. True
2. False

- Throughout my life I have noticed that I rarely feel strong positive or negative emotions
- I have sometimes felt that strangers were reading my mind
- My thoughts and behaviors are almost always disorganized
- In general, it is important for me to have close relationships with other people
- I often think that I hear people talking only to discover that there was no one there
- Most of the time I find it is very difficult to get my thoughts in order
- I have always preferred to be disconnected from the world
- I have felt that there were messages for me in the way things were arranged, like furniture in a room
- I often have difficulty following what someone is saying to me
- If given the choice, I would much rather be with another person than alone
- I believe that dreams have magical properties
- I often feel so mixed up that I have difficulty functioning
- Throughout my life, very few things have been exciting or interesting to me
- I sometimes wonder if there is a small group of people who can control everyone else's behavior

- My thoughts are so hazy and unclear that I wish that I could just reach up and put them into place
- Having close friends is not as important as people say
- I have had the momentary feeling that someone's place has been taken by a look-alike
- My thoughts and behaviors feel random and unfocused
- Generally, I do not have many thoughts or emotions
- There are times when it feels like someone is touching me when no one is actually there
- No matter how hard I try, I can't organize my thoughts
- Throughout my life, I have had little interest in dating or being in a romantic relationship
- I have had experiences with seeing the future, ESP or a sixth sense
- I find that I am very often confused about what is going on around me
- Most of the time I feel a desire to be connected with other people
- I often worry that other people are out to get me
- People find my conversations to be confusing or hard to follow
- There are just not many things that I have ever really enjoyed doing
- Some people can make me aware of them just by thinking about me
- My thoughts are almost always hard to follow
- I generally am not interested in being emotionally close with others
- I believe that there are secret signs in the world if you just know how to look for them
- I often have difficulty organizing what I am supposed to be doing
- My emotions have almost always seemed flat regardless of what is going on around me
- I often worry that someone or something is controlling my behavior
- I have trouble following conversations with others
- Spending time with close friends and family is important to me
- At times I have wondered if my body was really my own

Conspiracist Ideation

Please rate the following items: (matrix with the same 9 scale points for all statements below)

1. Completely false
2. Blank
3. Mostly false
4. Blank
5. Neither true nor false
6. Blank
7. Mostly true
8. Blank
9. Completely true

- A powerful and secretive group, known as the New World Order, are planning to eventually rule the world through an autonomous world government, which would replace sovereign government.
- SARS (Severe Acute Respiratory Syndrome) was produced under laboratory conditions as a biological weapon.
- The US government had foreknowledge about the Japanese attack on Pearl Harbor, but allowed the attack to take place so as to be able to enter the Second World War.
- US agencies intentionally created the AIDS epidemic and administered it to Black and gay men in the 1970s.
- The assassination of Martin Luther King, Jr., was the result of an organized conspiracy by US government agencies such as the CIA and FBI.
- The Apollo moon landings never happened and were staged in a Hollywood film studio.
- Area 51 in Nevada, US, is a secretive military base that contains hidden alien spacecraft and/or alien bodies.
- The US government allowed the 9/11 attacks to take place so that it would have an excuse to achieve foreign (e.g., wars in Afghanistan and Iraq) and domestic (e.g., attacks on civil liberties) goals that had been determined prior to the attacks.

- The assassination of John F. Kennedy was not committed by the lone gunman, Lee Harvey Oswald, but was rather a detailed, organized conspiracy to kill the President.
- In July 1947, the US military recovered the wreckage of an alien craft from Roswell, New Mexico, and covered up the fact.
- Princess Diana's death was not an accident, but rather an organized assassination by members of the British royal family who disliked her.
- The Oklahoma City bombers, Timothy McVeigh and Terry Nichols, did not act alone, but rather received assistance from neo-Nazi groups.
- The Coca Cola company intentionally changed to an inferior formula with the intent of driving up demand for their classic product, later reintroducing it for their financial gain.
- Special interest groups are suppressing, or have suppressed in the past, technologies that could provide energy at reduced cost or reduced pollution output.
- Government agencies in the UK are involved in the distribution of illegal drugs to ethnic minorities.

Big 5

These are phrases describing people's behaviors. Please use the rating scale below to describe how accurately each statement describes you. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age.

1. Very inaccurate
2. Moderately inaccurate
3. Neither inaccurate nor accurate
4. Moderately accurate
5. Very accurate

- Am the life of the party
- Sympathize with others' feelings
- Get chores done right away

- Have frequent mood swings
- Have a vivid imagination
- Don't talk a lot
- Am not interested in other people's problems
- Often forget to put things back in their proper place
- Am relaxed most of the time
- Am not interested in abstract ideas
- Talk to a lot of different people at parties
- Feel others' emotions
- Like order
- Get upset easily
- Have difficulty understanding abstract ideas
- Keep in the background
- Am not really interested in others
- Make a mess of things
- Seldom feel blue
- Do not have a good imagination

Paranoia (suspicion)

For each of the thoughts below, how strongly do you believe it:

1. Do not believe it
2. Believe it a little
3. Believe it somewhat
4. Believe it a lot
5. Absolutely believe it

- I need to be on my guard against others
- There might be negative comments being circulated about me
- People deliberately try to irritate me

- I might be being observed or followed
- People are trying to make me upset
- People communicate about me in subtle ways
- Strangers and friends look at me critically
- People might be hostile towards me
- Bad things are being said about me behind my back
- Someone I know has bad intentions towards me
- I have a suspicion that someone has it in for me
- People would harm me if given an opportunity
- Someone I don't know has bad intentions towards me
- There is a possibility of a conspiracy against me
- People are laughing at me
- I am under threat from others
- I can detect coded messages about me in the press/TV/radio
- My actions and thoughts might be controlled by others

Probability and coincidences

Please rate the following item:

1. Never
2. Once or twice
3. A few times
4. Many times
5. Very often

How often have you, in general, come across curious or meaningful coincidences?

There are many types of coincidences: How often have you experienced coincidences falling in each of the following categories?

- Series or clusters of names, numbers, or events of the same kind (like coming repeatedly across a word, never heard before, in the space of a few hours)
- Spontaneous associations (like thinking of someone and running unexpectedly into that person soon afterwards)
- "Small-world" experiences like encountering a person that one had not seen in a long time in some very improbable place)
- Perception of something distant in space (like worrying about a person at the exact time in which that person is having an accident)
- Perception of something distant in time (like having a dream that then comes true)
- Unexpected solution of a problem (like meeting a friend who wants to sell his computer exactly when we were looking for one)
- "Guardian-angel" experiences (like not arriving on time at a job interview and then discovering that it has been for the best, because a much better chance, which we would otherwise have missed, turns up)

Demographics

Please choose your gender from the list below:

- Woman
- Man
- Nonbinary
- Gender fluid
- Agender
- if none of the above accurately describe your gender, please type it in below:

Do you identify as intersex?

- Yes
- No

Do you identify as transgender?

- Yes

- No

Please choose the option that best captures your level of education:

- Did not complete high school
- High school diploma or GED
- Some college or university, but no degree
- Associates degree or equivalent
- Bachelor's degree
- Some graduate school but no graduate degree
- Masters degree
- Ph.D.
- If none of the above accurately describes your level of education, please type your level of education below:

How would you describe your race/ethnicity?

Please indicate the intensity of your religious belief:

- Not at all intense
- Slightly intense
- Somewhat intense
- Moderately intense
- Very intense
- Extremely intense

Do you typically attend a weekly religious service?

- No
- Yes

How did you find out about the survey? Source checkboxes:

- A blog site (e.g., The Vaccine Blog, VAXOPEDIA, History of Vaccines, Voices for vaccines, etc.)
- Twitter
- Email or personal communication
- Facebook post
- Research pool web site
- Other (please describe briefly)

Please answer this question honestly. Your answer will have no effect on you, but it may help us to better understand the results:

How much effort did you put into the task?

- I did not try very hard, and you should probably not include my results
- I did my best and feel that my results should be included

Appendix B: Debriefing

That completes the survey! Thank you for your participation!

Our primary research goal was to evaluate a general model of how beliefs form and are maintained. Specifically, we wanted to evaluate the relationship between your experiences and your feelings about and attitudes towards vaccines.

Previous research we have done has shown that people's beliefs are based on the types of experiences that they've had. We were interested in knowing if vaccine beliefs would also show this relationship. We intentionally tried to recruit people with different attitudes towards vaccines so that we could evaluate this relationship as fully as possible. The questions addressed four things:

1. Your experience. There were four types of experience covered: your personal vaccine experience, other people's vaccine experiences that they told to you, stories about vaccines that you might have heard, and how much vaccine-related media you attend to. If you said you had any of these experiences, we asked follow-up questions about them.

2. We asked you about your beliefs and attitudes. This was about vaccines, vaccine hesitancy, and attitudes toward science.

3. We measured a lot of personality variables. We thought these variables might influence the relationship between experience and belief. Some of these might be more important for personal belief, some for other people's beliefs.

4. We asked questions about you so that we could understand who participated in the survey.

Based on what happens, these results may be useful to understand how people form beliefs. Our previous research has focused primarily on how personal experience affects belief. We chose to look at vaccine experience because we expect that other people's experiences might play more of a role, and that will allow us to evaluate other aspects of the model.

If you would like additional information about the project, you may contact:

The researchers:

- Kristopher Plattsmier (kjp3p@mtmail.mtsu.edu; Primary Investigator)
- William Langston (615/898-5489, william.langston@mtsu.edu; Faculty Advisor)

The Middle Tennessee State University Office of Compliance (615/494-8918, compliance@mtsu.edu)

Thanks again for your participation!

Appendix C: Recruitment Survey

Research opportunity:

I am collecting data for a project that I am doing for my masters thesis. I want to ask folks in the community to participate. If you are interested, please review the information and click the link below. This survey is pretty long, so you will need to have at least an hour available. You also need to be over the age of 18 to participate.

There are several parts to this project:

- Report experiences
- Report things you might believe in
- Describe your personality
- Answer some questions about yourself

The whole thing should take about an hour. There are a lot of questions to answer and some of them will require a little thinking.

If you're interested, you can click the link below. Thank you!

Click here for the survey:

https://mtsupsychology.az1.qualtrics.com/jfe/form/SV_diHdQODKP81pW8l

Here are your rights as a participant:

Project title: Experiences and personality (MTSU IRB number 21-1072 2q, PI

Kristopher Plattsmier, faculty advisor Dr. William Langston, approval date 11/18/2020, expiration date 06/30/2022)

- Your participation in this research is voluntary.
- You may skip any item that you don't want to answer, and you may stop the
- research at any time. Note that if you leave an item blank, you will be warned that you missed one, just in case it was an accident. You can still click that you don't want to answer.
- There are no risks associated with your participation besides possible discomfort with some of the questions.
- There are no real benefits to you from participating besides possibly learning something about the research.
- You will NOT be asked to provide any identifiable personal information.
- All efforts, within reason, will be made to keep the personal information in your research record private but total privacy cannot be promised. Your information may be shared with people at MTSU (such as the Middle Tennessee State University Institutional Review Board) or other agencies (such as the Federal Government Office for Human Research Protection) if you or someone else is in danger or if we are required to do so by law.

If you have questions about this research, you may contact Kristopher Plattsmier

(kjp3p@mtmail.mtsu.edu) or William Langston (615/898-5489, william.langston@mtsu.edu) or the Middle Tennessee State University Office of Compliance (615/494-8918, compliance@mtsu.edu).

Appendix D: Approved Informed Consent

Use the following text for administering informed consent through Qualtrics

Welcome to the survey!

This is a research project designed to help us evaluate your experiences. We are going to ask you about your experience with vaccines, and about other people's experiences that you might have heard about. We will also ask you about the properties of your experiences and how they made you feel. We will also ask you about some things you might believe, and some questions about your personality. Refer below for MTSU IRB oversight information:

- Project title: Experiences and personality
- IRB number 21-1072 2q
- PI Kristopher Plattsmier; Faculty Advisor Dr. William Langston
- Approval Date: 11/18/2020 Expiration Date: 06/30/2022

There are several parts to this project. These will be in a different random order for each person, but the four parts are:

- Report experiences
- Report things you might believe in
- Describe your personality
- Answer some questions about yourself

The whole thing should take about an hour, but the actual time will vary based on what you report. There are a lot of questions to answer. Some of them will require a little thinking. Please take your time and try to answer them all carefully. There is no compensation for participation.

Here are your rights as a participant:

- Your participation in this research is voluntary.
- You may skip any item that you don't want to answer, and you may stop the research at any time. Note that if you leave an item blank, you will be warned that you missed one, just in case it was an accident. You can still click that you don't want to answer.
- There are no risks associated with your participation besides possible discomfort with some of the questions.
- There are no real benefits to you from participating besides possibly learning something about the research.
- You will NOT be asked to provide any identifiable personal information.
- All efforts, within reason, will be made to keep the personal information in your research record private but total privacy cannot be promised. Your information may be shared with people at MTSU (such as the Middle Tennessee State

University Institutional Review Board) or other agencies (such as the Federal Government Office for Human Research Protection) if you or someone else is in danger or if we are required to do so by law.

If you have questions about this research, you may contact Kristopher Plattsmier (kjp3p@mtmail.mtsu.edu) or William Langston (615/898-5489, william.langston@mtsu.edu) or the Middle Tennessee State University Office of Compliance (615/494-8918, compliance@mtsu.edu).

This contact information will be presented again at the end of the experiment. If you're ready to get started, please enter your age and make your choice below before clicking the arrow button (that button will be used to navigate through the entire experiment).

Thanks again for volunteering your time to this project!

[For the MTSU sample, this note will be added.]

Note: If you do not click on the arrow on the final screen (to go past the screen thanking you for participating), you will not be granted credit in Sona for your participation. Even if you're stopping early by skipping to the end, you need to click the final arrow to

receive credit. You will know that you are successful because you will automatically return to Sona.

Please enter your age:

I have read the information above. I am at least 18 years old. I believe I understand the purpose, risks, and benefits of the research, and I know what I will be expected to do.

I consent to participate

I decline to participate (under 18 or decline will go to the end of the survey)

Appendix E: IRB Approval

INSTITUTIONAL REVIEW BOARD
Office of Research Compliance, 010A
Sam Ingram Building,

2269 Middle Tennessee Blvd

Murfreesboro, TN 37129

FWA: 00005331/IRB Regn.. 0003571

IRBN007 – EXEMPTION DETERMINATION NOTICE

Wednesday, November 18, 2020

Protocol Title ***The Role of Personality and Experience in Vaccine Hesitancy*** Protocol ID **21-1072 2q**

Principal Investigator **Kristopher Plattsmier** (Student)

Faculty Advisor William Langston

Co-Investigators NONE

Investigator Email(s) *kjp3p@mtmail.mtsu.edu; william.langston@mtsu.edu*

Department/Affiliation Psychology

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR

46.101(b)(2) within the research category ***(2) Educational Tests, surveys, interviews or observations of public behavior*** *(Qualtrics Survey).* A summary of the IRB action and other particulars of this protocol are shown below:

IRB Action	**EXEMPT from furhter IRB review***		
Date of Expiration	**6/30/2022**	*Date of Approval:* **11/18/20**	*Recent Amendment:* NONE
Sample Size	THREE HUNDRED (300)		
Participant Pool	**Healthy adults (18 or older) - MTSU SONA, General Adults and FaceBook users**		
Exceptions	1. Online consent followed by internet-based survey using Qualtrics is permitted 2. Participant inormation retention is permitted to comply with SONA Policy		
Type of Interaction	Virtual/Remote/Online Interview/survey In person or physical– Mandatory COVID-19 Management (refer next page)		
Mandatory Restrictions	**1. All restrictions for exemption apply.** **2. The participants must be 18 years or older.** **3. Mandatory ACTIVE informed consent. Identifiable information including, names, addresses, voice/video data, must not be obtained.** **4. NOT approved for in-person data collection.**		
Approved IRB Templates	*IRB Templates:* MTSU SONA Recruitment *Non-MTSU Templates:* Recruitment script & Online Informed Consent Script		
Research Inducement	Course Credit (MTSU SONA only)		
Comments	NONE		

***Although this exemption determination allows above defined protocol from further IRB review, such as continuing review, MTSU IRB will continue to give regulatory oversight to ensure compliance.

Summary of the Post-approval Requirements: The PI and FA must read and abide by the post-approval conditions (Refer "*Quick Links*" in the bottom):

• ***Final Report:*** The Faculty Advisor (FA) is responsible for submitting a final report to close-out this protocol before **6/30/2022**; if more time is needed to complete the data collection, the FA must request an extension by email. REMINDERS WILL NOT BE SENT. **Failure to close-out (or request extension) may result in penalties** including cancellation of the data collected using this protocol or withholding student diploma.

• ***Protocol Amendments***: IRB approval must be obtained for all types of amendments, such as:

o Addition/removal of subject population and sample size.

o Change in investigators.

o Changes to the research sites – appropriate permission letter(s) from may be needed.

o Alternation to funding.

o Amendments must be clearly described in an addendum request form submitted by the FA.

o The proposed change must be consistent with the approved protocol and they must comply with exemption requirements.

• ***Reporting Adverse Events:*** Research-related injuries to the participants and other events , such as, deviations & misconduct, must be reported within 48 hours of such events to compliance@mtsu.edu. • ***Research Participant Compensation:*** Compensation for research participation must be awarded as proposed in Chapter 6 of the Exempt protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office. • ***COVID-19:*** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

COVID-19 Management:

The FA must enforce social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

• The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."

• The FA must enforce the MTSU's "Return-to-work" questionnaire found in Pipeline must be filled and signed by the investigators on the day of the research interaction prior to physical contact.

• PPE must be worn if the participant would be within 6 feet from the each other or with an investigator. • Physical surfaces that will come in contact with the participants must be sanitized between use • **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect

the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the PI will be instructed to carryout remedial measures if needed.

Post-approval Protocol Amendments:

The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would not result in the cancellation of the protocol's eligibility for exemption. ***Only THREE procedural amendments will be entertained per year*** *(changes like addition/removal of research personnel are not restricted by this rule).*

Date	Amendment(s)	IRB Comments
NONE	NONE.	NONE

Post-approval IRB Actions:

The following actions are done subsequent to the approval of this protocol on request by the PI or on recommendation by the IRB or by both.

Date	IRB Action(s)	IRB Comments
NONE	NONE.	NONE

Mandatory Data Storage Requirement:

All research-related records (signed consent forms, investigator training, etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data must be stored for at least three (3) years after the study is closed. Additionally, the Tennessee State data retention requirement may apply (*refer "Quick Links" below for policy 129*). Subsequently, the data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects. **The IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this notice**. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board

Middle Tennessee State University

Quick Links:

- Post-approval Responsibilities: http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php
- Exemption Procedures: https://mtsu.edu/irb/ExemptPaperWork.php
- MTSU Policy 129: Records retention & Disposal: https://www.mtsu.edu/policies/general/129.php

Appendix F: IRB Amendment

IRB.
INSTITUTIONAL

REVIEW BOARD

Office of Research
Compliance, 010A
Sam Ingram
Building,

2269 Middle Tennessee Blvd

Murfreesboro, TN 37129

FWA: 00005331/IRB Regn.. 0003571

IRBN007 – EXEMPTION DETERMINATION NOTICE

Wednesday, April 28, 2021

Protocol Title ***The Role of Personality and Experience in Vaccine Hesitancy*** Protocol ID **21-1072 2q**

Principal Investigator **Kristopher Plattsmier** (Student)

Faculty Advisor William Langston

Co-Investigators NONE

Investigator Email(s) *kjp3p@mtmail.mtsu.edu; william.langston@mtsu.edu*

Department/Affiliation Psychology

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category ***(2) Educational Tests, surveys, interviews or observations of public behavior*** *(Qualtrics Survey).* A summary of the IRB action and other particulars of this protocol are shown below:

IRB Action	**EXEMPT from furhter IRB review***		
Date of Expiration	**6/30/2022**	*Date of Approval:* **11/18/20**	*Recent Amendment:* **4/28/21**
Sample Size	THREE HUNDRED (300)		
Participant Pool	**Healthy adults (18 or older): (a) MTSU SONA, (b) General Adults, (c) FaceBook users, and (d) Amazon Mechanical Turk**		
Exceptions	1. Online consent followed by internet-based survey using Qualtrics is permitted 2. Participant inormation retention is permitted to comply with SONA Policy		
Type of Interaction	Virtual/Remote/Online Interview/survey In person or physical– Mandatory COVID-19 Management (refer next page)		
Mandatory Restrictions	**1. All restrictions for exemption apply.** **2. The participants must be 18 years or older.** **3. Mandatory ACTIVE informed consent. Identifiable information including, names, addresses, voice/video data, must not be obtained.** **4. NOT approved for in-person data collection.** **5. Participant identity must not be added to the compensation documentation.**		
Approved IRB Templates	*IRB Templates:* MTSU SONA Recruitment *Non-MTSU Templates:* Recruitment script & Online Informed Consent Script		

Research Inducement	Course Credit (MTSU SONA only) and $1.50 (Amazon Mechanical Turk)
Comments	NONE

***Although this exemption determination allows above defined protocol from further IRB review, such as continuing review, MTSU IRB will continue to give regulatory oversight to ensure compliance.

Summary of the Post-approval Requirements: The PI and FA must read and abide by the post-approval conditions (Refer "*Quick Links*" in the bottom):

• ***Final Report:*** The Faculty Advisor (FA) is responsible for submitting a final report to close-out this protocol before **6/30/2022**; if more time is needed to complete the data collection, the FA must request an extension by email. REMINDERS WILL NOT BE SENT. **Failure to close-out (or request extension) may result in penalties** including cancellation of the data collected using this protocol or withholding student diploma.

• ***Protocol Amendments***: IRB approval must be obtained for all types of amendments, such as:

o Addition/removal of subject population and sample size.

o Change in investigators.

o Changes to the research sites – appropriate permission letter(s) from may be needed.

o Alternation to funding.

o Amendments must be clearly described in an addendum request form submitted by the FA. o The proposed change must be consistent with the approved protocol and they must comply with exemption requirements.

• ***Reporting Adverse Events:*** Research-related injuries to the participants and other events , such as, deviations & misconduct, must be reported within 48 hours of such events to compliance@mtsu.edu.

• ***Research Participant Compensation:*** Compensation for research participation must be awarded as proposed in Chapter 6 of the Exempt protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office.

• ***COVID-19:*** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

COVID-19 Management:

The FA must enforce social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

- The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."
- The FA must enforce the MTSU's "Return-to-work" questionnaire found in Pipeline must be filled and signed by the investigators on the day of the research interaction prior to physical contact.
  - PPE must be worn if the participant would be within 6 feet from the each other or with an investigator. • Physical surfaces that will come in contact with the participants must be sanitized between use • **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect

    the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the PI will be instructed to carryout remedial measures if needed.

Post-approval Protocol Amendments:

The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would not result in the cancellation of the protocol's eligibility for exemption. ***Only THREE procedural amendments will be entertained per year*** *(changes like addition/removal of research personnel are not restricted by this rule).*

Date	Amendment(s)	IRB Comments
04/28/2021	Amazon Mechanical Turk workers are added to the target population pool. Specific recruitment script and informed consent script are added.	IRBA2021-240

Post-approval IRB Actions:

The following actions are done subsequent to the approval of this protocol on request by the PI or on recommendation by the IRB or by both.

Date	IRB Action(s)	IRB Comments
NONE	NONE.	NONE

Mandatory Data Storage Requirement:

All research-related records (signed consent forms, investigator training and etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application.

The data must be stored for at least three (3) years after the study is closed. Additionally, the Tennessee State data retention requirement may apply (*refer "Quick Links" below for policy 129*). Subsequently, the data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects. **The IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this notice**. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board

Middle Tennessee State University

Quick Links:

- Post-approval Responsibilities: http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php
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