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A Randomized Controlled Trial of an Information Intervention to Bolster COVID-19 Vaccination Intention Among People With Purity Concerns

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Objective: Previous literature has indicated a strong negative correlation between the moral foundation of purity/sanctity and vaccination rates. The current research investigated how purity concerns impact COVID-19 vaccination hesitancy and tested an information intervention to bolster vaccination intention among people with purity concerns. **Method:** Study 1 surveyed 566 Republicans and Republican-leaning Independents in the United States. Study 2 was a between-subject-designed survey experiment that investigated the impact of three statements on the COVID-19 vaccination attitudes and intentions of 637 Republicans and Republican-leaning Independents. Statement 1 argued that vaccines are not impure from a scientific perspective; Statement 2 made the same argument with quotes from the Bible; and Statement 3 was a control statement. **Results:** Study 1 established a significant correlation between the existence of vaccination history and purity as a moral foundation. Study 2 found that among those with no COVID-19 vaccination history, statements arguing that vaccines are not impure from either a scientific perspective or a religious perspective improved attitudes toward vaccination and intention to get vaccinated. **Conclusion:** Purity concerns can be leveraged as a way to bolster vaccination rates, especially among conservatives. However, the impurity perception only mediated the causal relationship between the treatment and the attitude toward vaccines (but not the actual intention), suggesting that changes in the actual vaccination behavior are subject to factors other than purity concerns.

Public Significance Statement

So far, Republicans have shown a low COVID-19 vaccination rate, which is associated with beliefs about the purity/sanctity of their bodies. We conducted two interventions to reassure Republicans that vaccines are not impure, resulting in a more positive attitude toward vaccines and an increased willingness to get vaccinated among Republicans and Republican-leaning Independents. This study highlights the significance of acknowledging moral concerns in vaccination campaigns, particularly among vaccine-hesitant conservatives.

Keywords: vaccination, persuasion, attitude change, behavioral change

Supplemental materials: <https://doi.org/10.1037/hea0001295.supp>

In the United States, conservatives are much more reluctant to get vaccinated against COVID-19 than liberals. As of August 2022, the between-party vaccination rate gap was more than 20 percentage

points: more than 85% of Democrats were fully vaccinated, while about one-third of the Republicans received no vaccination shots (Centers for Disease Control and Prevention, 2022; Lopes et al.,

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Data and codes needed to replicate the results are available at <https://osf.io/cwxpj/>.

Catherine Chen served as lead for conceptualization, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing—original draft, and writing—review

and editing. Zhihan Cui served as lead for data curation and funding acquisition, contributed equally to conceptualization, investigation, methodology, project administration, resources, software, supervision, validation, and visualization, and served in a supporting role for formal analysis, writing—original draft, and writing—review and editing. Yixi Chen served in a supporting role for conceptualization, writing—original draft, and writing—review and editing. Catherine Chen and Zhihan Cui share first authorship of this paper.

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2022). Identifying the reasons behind vaccination hesitancy helps researchers understand the collective psyche and directs ways to intervene.

Previous literature has documented multiple approaches to bolster the vaccination rate, especially among Republicans/conservatives, who are shown to be statistically more hesitant to get vaccinated. Many researchers have applied persuasion strategies consistent with conservative mindsets and values, including emphasizing in-group community values (Bokemper et al., 2021), such as highlighting the religious identity of information presenters (Chu et al., 2021; Viskupić & Wiltse, 2022), highlighting elite party cues (Pink et al., 2021), and even presenting videos of the former president Donald Trump endorsing the vaccine (Robertson et al., 2021). These interventions differed in their effect size, but they suggested that there was still room for persuading unvaccinated Republicans/conservatives to get vaccinated.

Liberals and Conservatives Rely on Different Moral Foundations

Relatively little research has focused on liberals' and conservatives' moral convictions to design health interventions, although previous research has indicated their apparent differences in how they make moral judgments. For instance, the Moral Foundations Theory (J. Graham et al., 2009, 2013, 2018; Haidt, 2007, 2012; Koleva et al., 2012) proposed that liberals and conservatives rely on the following five sets of values to different extents when they make judgments: harm/care, fairness/reciprocity, ingroup/loyalty, authority/respect, and purity/sanctity. People who rely more on the harm/care moral foundation are more reluctant to harm others when they make decisions; people who rely more on the fairness/reciprocity moral foundation are keener about equal chance and reciprocal relationships; people who rely more on the ingroup/loyalty moral foundation cherish more loyalty to a community they belong to; people who rely more on the authority/respect moral foundation are more unwilling to challenge authority; and people who rely more on the purity/sanctity moral foundation emphasize more cleanliness and religious sanctification. Liberals value virtues based on the first two foundations, while conservatives value virtues based on all five (J. Graham et al., 2009; Haidt & Graham, 2007; See Table 1 for a summary of the five moral foundations).

In this regard, when liberals and conservatives craft arguments based on their own moral convictions rather than the convictions of

the people they target to persuade, the arguments can be unpersuasive, or even offensive, to the recipients (Feinberg & Willer, 2019). However, many vaccination persuasion messages today rely on the moral foundation of harm/care (e.g., "Vaccines minimize the risk of harm to the vulnerable" and "Getting vaccines to protect the ones you love"), which might be more effective in persuading liberals than conservatives due to the misalignment between the moral foundation of the message and the targets.

The Moral Foundation of Purity/Sanctity and Vaccine Hesitancy

Among the three conservative-specific moral foundations, purity is the most frequently linked to health decisions and vaccine hesitancy. For instance, the purity moral foundation originates from the emotion of disgust for biological contaminants (Rozin et al., 2008), while the Center for Disease Control-recommended messenger Ribonucleic acid vaccines direct human bodies to produce copies of a protein on the outside of the coronavirus as an immune process (Centers for Disease Control and Prevention, 2021). Furthermore, the violation of the exterior envelope of the body (including gore and deformity) may elicit disgust and thus be interpreted as impure (Rozin et al., 2008), while the vaccination process involves body-membrane breaking (Reimer et al., 2022). Somewhat ironically, the biological and psychological instinct that protects people from contaminants may cultivate contagious disease transmission by enhancing vaccine hesitancy (Clay, 2017). Many studies indicated that purity concerns were strongly associated with vaccine hesitancy while care and fairness did not play a leading role (Amin et al., 2017; Betsch et al., 2018; Clifford & Wendell, 2016).

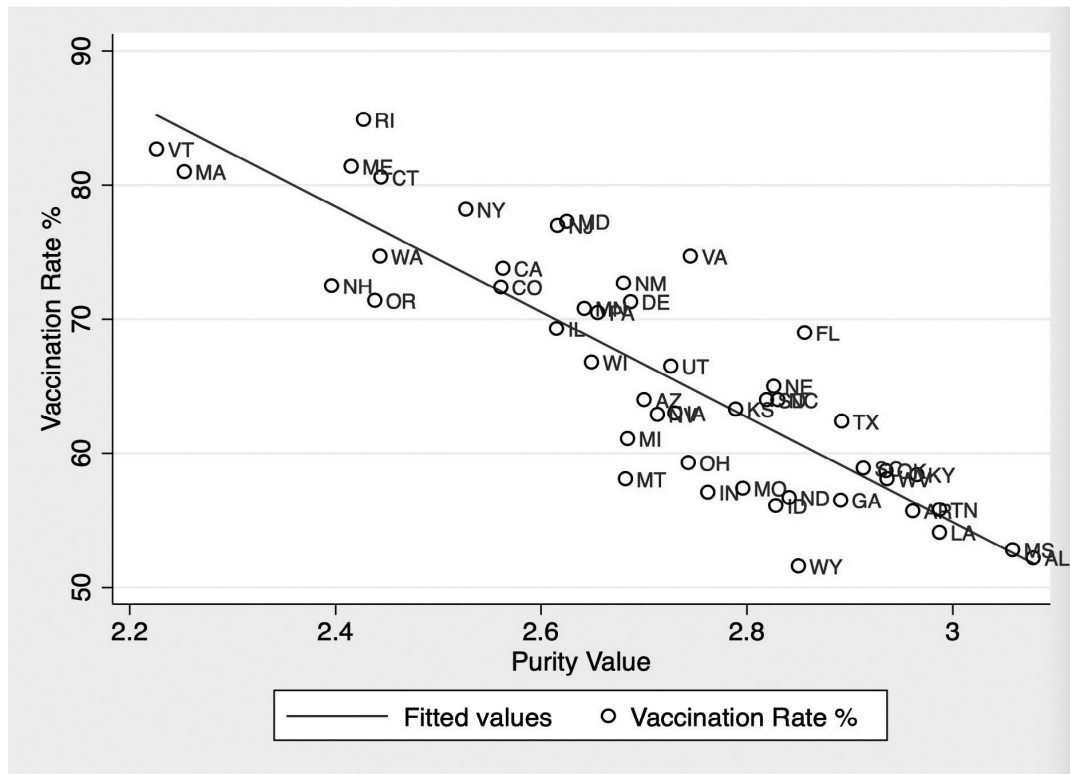
Other important empirical findings showed that purity is a solid predictor of COVID-19 vaccination rates across regions (Reimer et al., 2022). For instance, at the state level, the correlation coefficient between purity foundations (Hoover et al., 2022) and the COVID-19 vaccination rate was -0.86 , 95% CI $[-0.92, -0.81]$, Figure 1, which remained highly significant even when partisanship was controlled.

The Moral Foundations Theory and purity concerns have been used to design interventions for other precautionary measures for COVID-19, such as mask-wearing (DeMora et al., 2021; Dimant et al., 2022; Gelfand et al., 2022) and social distancing (A. Graham et al., 2020). However, despite the solid theoretical ground about the liberal-conservative differences in their moral foundations and the strong correlation between purity concern and vaccination rates, no research to date has explored the causal mechanisms beneath the relationship or designed interventions accordingly.

Table 1

The Moral Foundations Theory Proposed That Moral Intuitions Originate From Five Psychological Systems

Moral foundation	Appraisal	Content
Harm/care	Moral judgments are fundamentally based on appraisals of harm	When people judge any act to be morally wrong, it is because they perceive the act to cause harm
Fairness/reciprocity	Moral judgments are fundamentally based on appraisals of justice and fairness	When people judge any act to be morally wrong, it is because they perceive the act to be against equality or proportionality
Ingroup/loyalty	Moral judgments are fundamentally based on appraisals of loyalty to a social group you identify with	When people judge any act to be morally wrong, it is because they perceive the act to be threatening to the social group they identify with
Authority/respect	Moral judgments are fundamentally based on deference to legitimate authority and respect for traditions	When people judge any act to be morally wrong, it is because they perceive the act to be threatening to social hierarchy
Purity/sanctity	Moral judgments are fundamentally based on notions of striving to live in an elevated, less carnal, more noble way	When people judge any act to be morally wrong, it is because they perceive the act to be contaminating the purity of something

Figure 1*State-Level Correlation Between Purity Value and COVID-19 Vaccination Rates (Full Vaccination)*

The Current Research

The current research further explored the causal relationship between purity concerns and COVID-19 vaccine hesitancy. We conducted two preregistered studies on self-identified Republicans and Republican-leaning Independents. The first study was observational ($N = 566$), where we investigated the mechanisms by which purity moral foundation is associated with conservatives' past COVID-19 vaccination history. Study 2 ($N = 637$) designed and tested two information interventions to improve COVID-19 vaccination attitudes and intentions by arguing that vaccination does not make people impure: one information intervention argued that COVID-19 vaccines are not impure from a scientific perspective, and one information intervention made the same argument with quotes from a religious perspective.

Study 1: The Perception That Vaccines Are Impure Mediated the Relationship Between COVID-19 Vaccination History and Purity Moral Foundation

Study 1 tested the mechanisms by which purity moral foundation was associated with conservatives' past COVID-19 vaccination history. It was hypothesized that:

H1: The relationship between COVID-19 vaccination history and purity moral foundation would be mediated by the perception that vaccines are impure.

H2: The perception that vaccines are impure could be predicted by the idea that the human body is sacred.

Method

The design, measurements, and data analysis plans for both studies were preregistered at <https://osf.io/cwxxpj/>. Data and codes needed to replicate the results in the current study are also available through the link. Both studies were approved by the IRB of UCLA (IRB#22-000281) and supported by the research grant for postdoctoral scholars and faculty members at the Behavioral Decision Making Department of the Anderson School of Management, UCLA (FAU number: 400954-Z3-61070-07).

Study Population Recruitment

Participants were recruited through CloudResearch's MTurk Toolkit (Litman et al., 2017). MTurk (also known as Amazon Mechanical Turk) is a microtask platform connecting "requesters" (in our case, survey designers) with "workers" (people filling out surveys). CloudResearch is a third-party platform that helps experimental designers connect with MTurk workers to effectively acquire high-quality responses. To guarantee data quality, we only recruited subjects who were included in the approved list by CloudResearch and had a sufficiently high rate (93%) of MTurk approval. Respondents completed the survey between March 31 and April 6, 2022. Participants needed to self-identify as Republicans or

Republican-leaning Independents to participate in the study. To minimize potential selection bias, participants were not informed of the COVID-related nature of the experiment in the consent process. Instead, they were only told that they would be asked about their attitudes and decisions related to health. Informed consent was obtained from all study participants.

Measured Variables

COVID-19 Vaccination History. Measured with, “Have you taken at least one vaccination shot for COVID-19, or not?” Responses were coded as 1 (have not taken any vaccination shots for COVID-19) and 0 (have taken at least one vaccination shot for COVID-19), respectively. A summary of all measures in Study 1 and Study 2 is available in the online supplemental materials.

The Perception That Vaccines Are Impure. Measured with, “To what extent do you agree with the statement below? Being vaccinated for COVID-19 makes me impure.” Response options ranged from *strongly agree* to *strongly disagree* with 7 points in total and were coded as 1–0 with equal intervals in between.

Purity Moral Foundation. Measured with six questions obtained from moralfoundations.org (J. Graham et al., 2008, 2009, 2013). Respondents were first asked to what extent were the following considerations relevant to their thinking when deciding whether something was right or wrong. The items were “Whether or not someone violated standards of purity and decency,” “Whether or not someone did something disgusting,” and “Whether or not someone acted in a way that God would approve of.” Response options were a 6-point scale ranging from *extremely relevant* to *not at all relevant* and were coded as 1–0 with equal intervals in between. Respondents were then asked to what extent they agreed with the following items: “People should not do things that are disgusting, even if no one is harmed,” “I would call some acts wrong on the grounds that they are unnatural,” and “Chastity is an important and valuable virtue.” Response options ranged from *strongly agree* to *strongly disagree* on a 6-point scale and were coded as 1–0 with equal intervals in between. A purity foundation score was calculated as the mean response to the six questions mentioned above for each participant. Cronbach’s α was calculated for the six items.

Sacredness. Participants were asked to what extent they agreed with the following items: (a) My body is sacred; (b) Foreign substances contaminate the sacredness of my body; (c) We should strive to live in a divine way; and (d) I do not want foreign substances polluting my blood. Response options were a 7-point rating scale ranging from *strongly agree* to *strongly disagree* and were coded as 1–0 with equal intervals in between.

Statistical Analysis

Mediation Analysis. H1 concerned the mechanism in which one’s purity moral foundation was associated with their vaccination history, and we conducted a mediation analysis to test it. Vaccination history was treated as the dependent variable, purity moral foundation was treated as the independent variable, and the perception that vaccines are impure was treated as the mediator. We used the “mediate” function in the *mediation* package (Tingley et al., 2014) to estimate the mediation model and compute the standard errors through nonparametric bootstrap. The number of simulations was 1,000, the default of the package.

Structural Equation Modeling. To test H2, we used structural equation modeling to find out the latent structure of *Perceived sacredness of the body*. *Perceived sacredness of the body* was estimated as a latent variable that was derived from the principal components of the four questions on body sacredness. We used this latent variable to predict the perception of impurity directly. We used the “sem” function in the *lavaan* package (Rosseel, 2012) to estimate the model and visualized it with the “get_layout” and “prepare_graph” functions in the *tidySEM* package (van Lissa, 2020) in R.

Results

Descriptive statistics for major demographic and dependent variables for Study 1 are available in Table 2. The six items measuring respondents’ purity moral foundation had a Cronbach’s α of 0.816, indicating reliable internal consistency. A logistic regression indicated that purity moral foundation significantly predicted whether the respondent was unvaccinated, $B = 1.67$, standardized $\beta = 0.35$, $z = 3.80$, $p < .001$, conceptually replicating Reimer et al. (2022). Detailed test statistics for all analyses of Studies 1 and 2 are available in the online supplemental materials.

The relationship between COVID-19 vaccination history and purity moral foundation was fully mediated by the perception that vaccines are impure: average causal mediation effect (ACME) = 0.20, 95% CI [0.13, 0.28], $p < .001$; average direct effect (ADE) = 0.14, [−0.04, 0.29], $p = .13$. On average, for two people with the same level of purity moral foundation, the person who completely perceived vaccines to be impure is 20 percentage points less likely to be vaccinated than the person who perceived vaccines to be not impure at all. Therefore, H1 was supported.

The perception that COVID-19 vaccines are impure was strongly associated with the belief that the human body is sacred, which was measured by four items (Cronbach’s $\alpha = 0.741$, showing its single-factor property). One *SD* of increase in the perception that the body was sacred is associated with 0.56 *SD* of increase in the perception that vaccines are impure, Goodness-of-fit Index = .936, Comparative fit index = .873, standardized root mean square residual = .07 (Figure 2). H2 was supported.

Study 2: Purity-Related Cues Increased Republicans’ Vaccine Attitude and Intention

Study 1 found that the relationship between COVID-19 vaccination history and purity moral foundation was mediated by the perception that vaccines are impure. Furthermore, the perception that vaccines are impure was driven by the perception that the human body is sacred. These results further highlighted the possibility of leveraging purity concerns to persuade conservatives to get vaccinated. Therefore, we tested whether presenting conservatives with statements arguing that vaccines are not impure could increase their vaccination attitude and intention. Two information interventions were designed and tested against an irrelevant control message, one suggesting that vaccines are not impure from a scientific perspective and one from a religious perspective.

How the Materials Were Designed?

Both information intervention materials were intended to convey the message that vaccines are not impure. The authors designed the

Table 2
Descriptive Statistics for Major Demographic and Dependent Variables for Study 1 (N = 566)

Characteristics	N	%		N	%
<i>Sociodemographic characteristics</i>			Annual household income, group		
Gender			\$10,000 or less	25	4.42
Male	233	41.17	\$10,000–\$20,000	32	5.65
Female	329	58.13	\$20,000–\$30,000	46	8.13
Others/not disclose	4	0.7	\$30,000–\$40,000	54	9.54
Age group, years			\$40,000–\$50,000	55	9.72
18–24	25	4.42	\$50,000–\$75,000	117	20.67
25–34	148	26.15	\$75,000–\$100,000	98	17.31
35–44	183	32.33	\$100,000–\$150,000	88	15.55
45–54	110	19.43	\$150,000 or more	51	9.01
55 or above	100	17.67			
Average	42		<i>Reports about COVID-19 vaccination status and attitude</i>		
Partisanship identity			Own status of COVID-19 vaccination		
Strong Republican (three)	95	16.78	Fully vaccinated with a booster (third shot)	185	32.69
Republican (two)	240	42.4	Fully vaccinated without a booster	174	30.74
Independent Leaning Republican (one)	231	40.81	Partially vaccinated (with one shot)	9	1.59
Independent	0		Unvaccinated	198	34.98
Independent Leaning Democrat	0		Perception that the vaccine is impure		
Democrat	0		Strongly disagree (0)	182	32.16
Strong Democrat	0		Disagree (1/6)	135	23.85
Average		1.76	Somewhat disagree (2/6)	48	8.48
Highest level of education			Neither agree nor disagree (3/6)	94	16.61
Eighth grade or less	2	0.35	Somewhat agree (4/6)	41	7.24
Some high school	2	0.35	Agree (5/6)	26	4.59
Graduated high school	71	12.54	Strongly agree (1)	40	7.07
Some college	152	26.86	Average		0.31
Graduated college	255	45.05	Belief that the body is sacred		
Postgraduate	84	14.84	<i>Item—average scores (mapped on a 0–1 scale)</i>		
Race (multiple choices allowed)			My body is sacred		0.57
White (including Hispanic)	483	85.34	Foreign substances contaminate the sacredness of my body		0.34
Black or African American	37	6.54	We should strive to live in a divine way		0.53
American Indian/Alaska Native	10	1.77	I don't want foreign substances polluting my blood		0.50
Asian	38	6.71	Average purity moral foundation (mapped on a 0–1 scale)		0.48
Native Hawaiian/Other Pacific Islander	3	0.53			
Some other race	10	1.77			

intervention texts together. The “scientific” statement explained how vaccination triggered the immune process. It highlighted that the process was natural and thus should not be considered impure. The “religious” statement quoted scripture from the books of *Jeremiah* and *Matthew* and argued that vaccines should be regarded as a form of His Divine Healing and thus not impure. The “control” statement intended to avoid any potential priming effect of COVID-19 or vaccines, so it used an irrelevant topic with a similar length.

Hypotheses

It was hypothesized that:

H3: Compared with a neutral statement, both information interventions would prompt people to perceive getting a COVID-19 vaccine to be a better idea (H3a), would prompt people to perceive COVID-19 vaccines to be less impure (H3b), and would increase people's tendency to get vaccinated against COVID-19 (H3c).

H4: Republicans would find religious statements more persuasive than scientific statements (H4a), and therefore, the religious

message would be more effective in bolstering vaccination attitude (H4b) and intention (H4c).

H5: Changes in COVID-19 vaccination attitude, intention, and perceived purity of the COVID-19 vaccine would be mediated by the emotions of relief (H5a), anger (H5b), and disgust (H5c).

H6: The perception that vaccines are impure would mediate the relationship between the treatment statement and COVID-19 vaccination attitude (H6a)/intention (H6b).

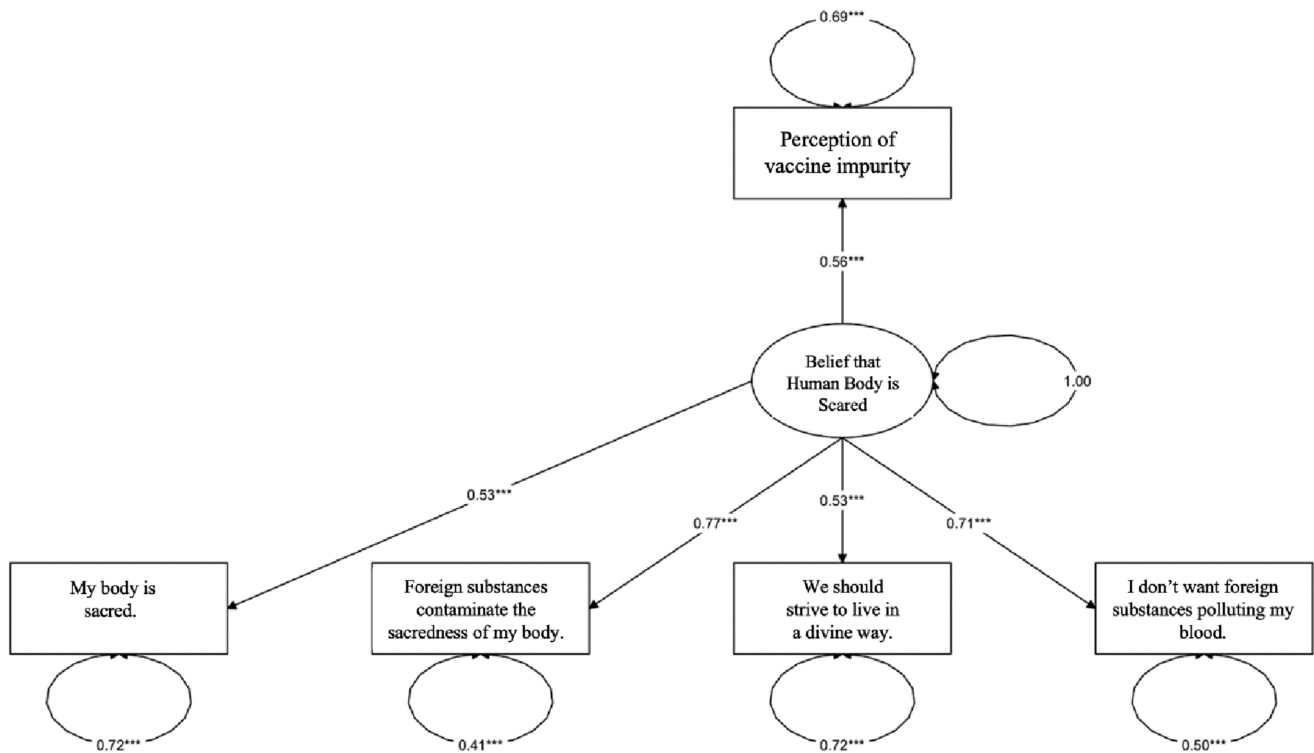
Method

Study Population Recruitment

Participants were recruited through CloudResearch's MTurk channel. Participants who entered the study needed to (a) be currently unvaccinated, (b) self-identify as a Republican or Republican-leaning Independent, and (c) have not participated in Study 1. Respondents completed the survey between August 14 and August 21, 2022. Like in Study 1, participants were not informed of the COVID-related nature of the study but were only

Figure 2

The Perception That Vaccines Are Impure Is Strongly Associated With the Belief That the Human Body Is Sacred



told that the survey was about health attitudes. Subjects were excluded from the experiment if they did not satisfy eligibility requirements. Based upon Fritz and MacKinnon (2007) and our three-group design, we preregistered for a sample size of 606 and hired 637 participants.

Exposure to Intervention

After informed consent and screening, eligible participants were randomly assigned to read one of the three materials below for at least 30 s. The materials were of similar length. We labeled the three materials as "Science," "Bible," and "Control" below. The participants were blind to the labeling of the materials.

The "Science" material was written as follows,

COVID-19 vaccines are not impure, because they function by activating your own antibodies. The COVID-19 vaccine does not contain a live virus that causes COVID-19. What it does is simply induce your cells to generate substances that get your body ready in case you contract the virus. This is a natural process, just as you put on your coat in winter and store them in the off-season. After the body produces these substances, it discards all of the vaccine ingredients, just as it would discard any substance that cells no longer need. This process is a part of normal body functioning, and you will generate antibodies of your own. Thus, a vaccine should not be considered impure.

The "Bible" material was written as follows,

According to the Bible, COVID-19 vaccines should be regarded as a form of His Divine Healing and thus not impure. The COVID vaccine has been developed by scientists, whose hands are guided by God, to

combat the disease. God did not create disease, as all His creation was meant for good, not for evil (Jeremiah 29:11). The development of vaccines is thus one way of His divine healing. Thus, it should not be considered impure. In combination with the power of prayer, we may guard our health and those of others. Getting vaccinated is another tangible means that we can protect our loved ones and our neighbors, many of whom have not yet received the assurance from Jesus Christ. Thus, vaccinating is a procedure that is morally pure.

And the "Control" material, adapted from Cui et al. (2022), wrote,

If you ignore office culture & protocol as a new employee, you will bring trouble to yourself at work. Every office has its own norms of functioning and work practices. The biggest favor you can do yourself as a new employee is to observe and adapt to this routine, instead of following your previous office's schedule or simply doing as you please. Be it the way office communication is carried out, paperwork is handled, workflow takes place, or dress code is followed, you should pay close attention and ask questions, if necessary. If you try to be different or show disregard for the work processes and protocol, you not only risk being ostracized by colleagues but, more importantly, it could harm your career as you may end up offending your boss.

Measures

Emotional Responses. Five emotional reactions to the statement were gauged with the question, "How _____ are you by the statement you just saw?" The emotions/variables were surprised, disgusted, troubled, angry, and relieved. The response options for all five questions were identical except for the adjectives. For example, response options for "How surprised are you by the statement

you just saw?” were “extremely surprised,” “very surprised,” “moderately surprised,” “slightly surprised,” and “not at all surprised.” Responses were coded as 1 to 0 with equal intervals in between.

Attitude Toward COVID-19 Vaccines. Measured with, “Do you think getting the COVID-19 vaccine is a good idea or a bad idea?” Response options were “good idea,” “bad idea,” and “neither a good nor bad idea.” If the respondent answered either “good” or “bad” idea, respective variables for how good and how bad would follow up accordingly: “How good of an idea is it to get a COVID-19 vaccine?” or “How bad of an idea is it to get a COVID-19 vaccine?” Response options were “extremely good/bad,” “moderately good/bad,” and “slightly good/bad” (with the adjective being dependent on whether the respondent first called it a good or bad idea). “Extremely good,” “moderately good,” “slightly good,” “neither good nor bad,” “slightly bad,” “moderately bad,” and “extremely bad” were coded as 1–0 with equal intervals in between.

Perceived Persuasiveness of the Material. Measured with, “How persuasive do you perceive the statement you just saw to be?” Response options were “extremely persuasive,” “very persuasive,” “moderately persuasive,” “slightly persuasive,” and “not at all persuasive” and were coded as 1–0 with equal intervals in between.

COVID-19 Vaccination Intention. Measured with, “How likely are you to get at least one shot of a COVID-19 vaccine during the next 6 months?” Response options were “extremely likely,” “very likely,” “moderately likely,” “slightly likely,” and “not at all likely” and were coded as 1–0 with equal intervals in between.

Impurity Perceptions. Perceived impurity of the COVID-19 vaccine was measured with, “To what extent do you agree with the statement below?—Being vaccinated for COVID-19 makes me impure.” Response options ranged from *strongly agree* to *strongly disagree* with 7 points in total and were coded as 1–0 with equal intervals in between.

Participants were also asked to report their moral foundation of purity/sanctity with the same method in Study 1. Demographics (gender, age, income, education, race, Hispanic ethnicity) were collected.

Analysis

To test whether randomization was successful, we used the *balanceable* package (Chiapello, 2018) in Stata 14 to see if the demographics of participants were balanced across all experimental conditions.

We compared attitudes toward vaccinating against COVID-19 (H3a), perceived purity of COVID-19 vaccines (H3b), intentions to get vaccinated against COVID-19 (H3c), and perceived persuasiveness of the statements (H4) across conditions with *t*-tests. Effect sizes (Cohen’s *d*) were calculated with the “effectsize” function from the *effectsize* package (Ben-Shachar et al., 2020) in R.

Since H5 and H6 were concerned with the mechanisms in which the interventions worked, they were tested with mediation analyses following the same recipe as in Study 1. For H5, nine (3 × 3) mediation analyses were conducted. The independent variable was the treatment status. The dependent variables were attitudes toward vaccination, perceived purity of the COVID-19 vaccine, and intentions to get vaccinated, respectively. And the mediators were the emotions of relief, anger, and disgust, respectively.

For H6, two mediation analyses were conducted. The independent variable was the treatment status. The mediator was the perceived purity of the COVID-19 vaccine. And the dependent variables were attitudes toward vaccination and intentions to get vaccinated, respectively.

Results

No statistically significant differences in demographics across conditions were observed, indicating successful randomization (see Table S3 in the online supplemental materials for the balance table). Descriptive statistics for major variables for Study 2 are available in Table 3.

Compared with a neutral statement, a statement that convinced people that vaccines are not impure from a scientific perspective prompted people to perceive getting a COVID-19 vaccine to be a better idea, $t(425.63) = 3.79$, $p < .001$, Cohen’s $d = 0.37$, and increased people’s intention to get vaccinated against COVID-19, $t(383.54) = 4.50$, $p < .001$, Cohen’s $d = 0.43$, but it did not change perceived purity of COVID-19 vaccines, $t(425.93) = -1.15$, $p = .25$, Cohen’s $d = -0.11$.

Compared with a neutral statement, the statement that convinced people that vaccines are not impure from a religious perspective successfully led people to perceive getting a COVID-19 vaccine to be a better idea, $t(408.27) = 2.67$, $p = .008$, Cohen’s $d = 0.26$, prompted people to perceive COVID-19 vaccines to be less impure, $t(411.64) = -2.75$, $p = .006$, Cohen’s $d = -0.27$, and increased people’s intention to get vaccinated, $t(364.04) = -2.88$, $p = .004$, Cohen’s $d = 0.28$. Combining these two findings, we found sufficient evidence to support H3a and H3c, but H3b was only partially supported.

Respondents did perceive the religious statement to be more persuasive, $t(424.08) = 3.34$, $p < .001$, Cohen’s $d = 0.32$, supporting H4a. However, the scientific and religious statements did not statistically significantly different in terms of their impact on respondents’ COVID-19 vaccination attitude, vaccine impurity perception, or vaccination intention (Figure 3). Therefore, there was no sufficient evidence to support Hypotheses H4b and H4c.

Mechanisms

Mediating Role of Emotions. We first investigated the mediating effects of emotions. When combining both treated groups, compared with the control group (i.e., both “Science” and “Bible” were coded as 1, and “Control” was coded as 0), the treatment effect on vaccination attitude was partially mediated by relief—ACME = 0.02, 95% CI [0.01, 0.04], $p = .008$; ADE = 0.06, [0.02, 0.10], $p < .001$; anger—ACME = -0.01, [-0.02, 0], $p = .006$; ADE = 0.10, [0.05, 0.14], $p < .001$; and disgust—ACME = -0.02, [-0.04, -0.01], $p < .001$; ADE = 0.11, [0.07, 0.15], $p < .001$. That is, respondents perceived getting vaccinated against COVID-19 to be a better idea because they felt more relieved, less angry, and less disgusted after seeing the statement.

The treatment effect on the perceived Impurity of COVID-19 vaccines was partially mediated by the emotion of anger—ACME = 0.02, 95% CI [0, 0.03], $p = .01$; ADE = -0.07, [-0.12, -0.02], $p = .008$ and disgust—ACME = 0.03, [0.01, 0.04], $p < .001$; ADE = -0.08, [-0.13, -0.03], $p = .002$, but not relief—ACME = 0.001, [-0, 0.01], $p = .72$; ADE = -0.06, [-0.11, 0],

Table 3*Descriptive Statistics for Major Demographic and Dependent Variables for Study 2*

Characteristics	N	%		N	%
<i>Sociodemographic characteristics</i>			Annual household income, group		
Gender			\$10,000 or less	21	3.3
Male	308	48.35	\$10,000–\$20,000	54	8.38
Female	326	51.18	\$20,000–\$30,000	77	12.09
Others	3	0.47	\$30,000–\$40,000	72	11.3
Age group, years			\$40,000–\$50,000	72	11.3
18–24	23	3.61	\$50,000–\$75,000	135	21.19
25–34	225	35.32	\$75,000–\$100,000	123	19.31
35–44	189	29.67	\$100,000–\$150,000	50	7.85
45–54	114	17.9	\$150,000 or more	33	5.18
55 or above	86	13.5			
Partisanship identity			<i>Self-reports about COVID-19 vaccination (all unvaccinated)</i>		
Strong Republican (3)	168	11.52	Attitude toward vaccination—good/bad idea		
Republican (2)	252	18.93	Extremely bad idea (0)	175	27.47
Independent Leaning Republican (1)	217	11.11	Bad idea (1/6)	121	19
Independent	0		Slightly bad idea (2/6)	33	5.18
Independent Leaning Democrat	0		Neither good or bad idea (3/6)	243	38.15
Democrat	0		Slightly good idea (4/6)	10	1.57
Strong Democrat	0		Good idea (5/6)	29	4.55
Average		1.92	Extremely good idea (1)	26	4.08
Highest level of education			Average		0.33
8th grade or less	0	0	Vaccination intention (likelihood)		
Some high school	8	14.4	Not likely at all (0)	453	7.11
Graduated high school	98	17.28	Slightly likely (1/4)	93	14.6
Some college	180	12.76	Moderately likely (1/2)	42	6.59
Graduated college	279	41.98	Very likely (3/4)	29	4.55
Postgraduate	72	11.11	Extremely likely (1)	20	3.14
Race (multiple choices allowed)			Average		0.13
White (including Hispanic)	550	86.3	Perception that the vaccine is impure		
Black or African American	58	9.11	Strongly disagree (0)	149	23.39
American Indian/Alaska Native	15	2.35	Disagree (1/6)	131	20.57
Asian	23	3.61	Somewhat disagree (2/6)	50	7.85
Native Hawaiian/Other Pacific Islander	3	0.47	Neither agree nor disagree (3/6)	166	26.06
Some other race	12	1.88	Somewhat agree (4/6)	56	8.79
Average of purity moral foundation on a 0–1 scale	637	0.585	Agree (5/6)	40	6.28
			Strongly agree (1)	45	7.06
			Average		0.37

$p = .03$. That is to say, respondents perceived the vaccine to be less impure because they felt less angry and less disgusted after seeing the statement.

The treatment effect on COVID-19 vaccination intention was partially mediated by the emotion of relief—ACME = 0.03, 95% CI [0.01, 0.05], $p = .01$; ADE = 0.06, [0.02, 0.09], $p < .001$. No mediating effect of anger—ACME = 0.001, [−0.01, 0], $p = .77$; ADE = 0.08, [0.05, 0.12], $p < .001$ or disgust—ACME = −0.003, [−0.01, 0], $p = .4$; ADE = 0.09, [0.05, 0.12], $p < .001$ was observed. That is to say, respondents intended to take a vaccination shot because they felt more relieved after seeing the statement. H5a–c were partially supported.

Mediating Role of the Perceived Purity of Vaccines. Next, we investigated whether the treatment effects on COVID-19 vaccination attitude and intention were mediated by the perception that vaccines are impure. The impurity perception mediated the relationship between the treatment statement and vaccination attitude—ACME = −0.02, 95% CI [−0.03, −0.01], $p < .001$; ADE = 0.07, [0.03, 0.11], $p = .004$ but not the actual vaccination intention—ACME = 0, [−0.004, 0.01], $p = .88$; ADE = 0.08, [0.05, 0.12], $p < .001$. Both statements did successfully increase respondents' vaccination attitudes and intentions. The increase in vaccination attitudes could be partially explained by decreases in the perceived

impurity of vaccines, but the increase in vaccination intention cannot be explained by such decreases.

Given the scientific statement had no impact on the perceived impurity of COVID-19 vaccines, we also ran the mediation analysis on the Control group and the Bible group only. Among the Bible group and the Control group, the perception that COVID-19 vaccines are impure did not mediate the relationship between the statement and the intention to get vaccinated against COVID-19, either: ACME = −0.003, 95% CI [−0.01, 0], $p = .31$; ADE = 0.07, [0.02, 0.11], $p = .004$. The Bible statement did increase people's intention but not through impurity perceptions. Therefore, H6a was partially supported, but H6b was not.

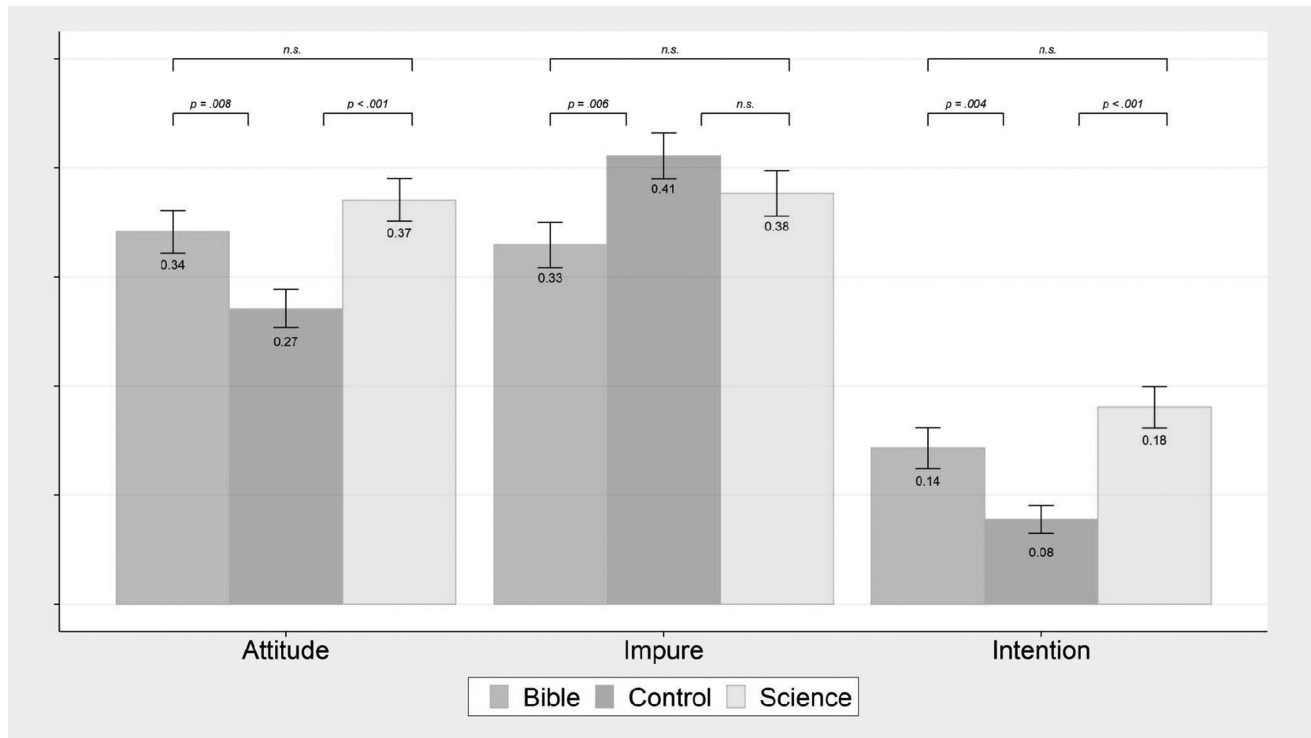
Nonpreregistered Analysis: Moderated Mediation Tests

One might wonder whether the mediating effect was moderated by respondents' purity moral foundation: if purity was not a concern for respondents, they were not motivated to get vaccinated after seeing the statement because the statement changed their perception of the impurity of the vaccine. There are reasons to believe that the mediating effect was only present among those whose purity moral foundation was high.

Nonetheless, we found no evidence of moderated mediation. No mediating effect was found even among those whose purity

Figure 3

Both the Scientific Statement and the Statement Citing Bible Significantly Improved COVID-19 Vaccination Attitude and Intention



concerns were in the highest quartile, regardless of whether the analysis was performed on the full sample—ACME = 0, 95% CI [−0.01, 0.01], $p = .85$; ADE = 0.01, [−0.04, 0.08], $p = .63$ or on the control and the Bible group—ACME = −0.003, [−0.02, 0], $p = .46$; ADE = 0.07, [0.01, 0.13], $p = .02$. This again indicated that the Bible statement did increase people's intention but not through impurity perceptions.

Discussion

Summary of Results

Study 1 found that the relationship between COVID-19 vaccination history and purity moral foundation was mediated by the perception that vaccines are impure. Furthermore, the perception that vaccines are impure was driven by the perception that the human body is sacred.

Study 2 increased people's COVID-19 vaccination attitudes and intentions with two statements, one arguing that vaccines are not impure from a scientific standpoint and one from a religious perspective. The purity-related arguments significantly improved the attitude and intention, but the channel was mostly not through purity: purity concerns partially mediated the relationship between the treatment statements and vaccination attitudes, but no mediating effects were observed for the relationship between the treatment statement and the actual vaccination intention. The mediation relationship was not moderated by the purity moral foundation, either.

Vaccination Attitude Versus Vaccination Intention

The current research indicated that attitudes toward vaccination can be improved by persuading people that vaccines are not impure, but changes in the actual vaccination intention cannot be attributed to changes in impurity concerns. Additionally, changes in the perceived purity of the COVID-19 vaccine and changes in the actual vaccination intention induced by the intervention messages were mediated by different sets of emotions: the treatment effect on the perceived impurity of the COVID-19 vaccine was partially mediated by the emotion of anger and disgust but not relief; the treatment effect on vaccination intention was partially mediated by the emotion of relief but not anger or disgust. This again implies that changes in purity concerns were less likely the sources of the changes in the actual vaccination intention.

Concerning this pattern, as another post hoc analysis, we found that in Study 1, the impurity perception correlated strongly with respondents' actual vaccination history, $r = -0.44$, 95% CI [−0.50, −0.38]. However, in Study 2, when focusing on Republicans and Republican-leaning Independents who had no COVID-19 vaccination shots up to date, we found that the perception that vaccines are impure correlated very weakly with their vaccination intention, $r = -0.02$, 95% CI = [−0.1, 0.059].

Both purity moral foundation and the perception that vaccines are impure correlated strongly with actual vaccination history but not with future vaccination intentions. We propose that this discrepancy might be explained by the cognitive dissonance theory (Festinger, 1962): those who had been already vaccinated were hesitant to

admit that vaccines are impure, since perceiving vaccines to be impure while being vaccinated brings cognitive dissonance. It is possible that some conservatives with impurity concerns got vaccinated for job requirements or other health concerns. To reduce cognitive dissonance, those who are already vaccinated are motivated to perceive the vaccines as less impure. As a result, we were able to observe the strong correlation between actual vaccination history and impurity perceptions. However, among those who are unvaccinated up to date, it is easier to change their vaccination-related attitudes through purity concerns but less so with actual vaccination intentions.

Nonetheless, why did our messages still successfully improve both vaccination attitude and intention? One possible reason, as suggested by the mediation analyses, is that a message in accordance with the participants' moral foundations made them relieved, reducing the fear of the potential risks of taking the vaccine. Another possible reason is that the treatment messages motivated respondents to deliberate. This conjecture is partially supported by the fact that the correlation between COVID-19 vaccination attitudes and intentions was higher among treated groups than for the control group—Science: $r = 0.70$, 95% CI [0.62, 0.76]; Bible: $r = 0.68$, [0.60, 0.75]; Control: $r = 0.50$, [0.39, 0.59]. Likely, the process of explaining why vaccines are not impure motivated respondents to think more carefully about vaccines in general (not merely about impurity itself), and the overall attitude and intention were improved.

Implications

Theoretical Implications

The current research has the following theoretical implications. First, previous literature has indicated that liberals and conservatives rely on different moral principles to make judgments (J. Graham et al., 2009, 2013, 2018; Haidt, 2007, 2012; Koleva et al., 2012), and such differences in moral foundations have been leveraged by researchers to design interventions on environmental protection (Feinberg & Willer, 2013), mask-wearing (DeMora et al., 2021), bolstering physical exercise (Mejova & Kalimeri, 2019), and many other activities. In the current research, we applied the theory to COVID-19 vaccination persuasion, extending the scope of the applications of the Moral Foundations Theory.

Second, the current research added to the understanding of conservatives' purity concerns: Study 1 indicated that vaccine impurity perceptions were associated with the idea that the human body is sacred, identifying one root of the purity concerns. Additionally, the mediation analyses conducted in Study 2 helped clarify the mechanisms by which emotions were associated with purity concerns.

More importantly, it added to the literature on how purity concerns were associated with COVID-19 vaccination attitude and intention. In the current study, the mediating role of purity concerns was not as high as what had been hypothesized. Nonetheless, the results are not meant to overturn previous literature on purity moral foundation. Instead, it is a good supplement to the current moral foundation literature concerning real-world intervention strategies.

Practical Implications

The practical implications of this study are straightforward. The message from both scientific and religious perspectives strongly

enhanced the vaccination intention, indicating that there are still spaces for effective persuasion even among those who have been hesitant to take the vaccines for 20 months.

As indicated in the present research, the connection between purity concerns and vaccination attitudes is reassuring. Therefore, purity is a promising channel to focus on if the goal is to bolster the COVID-19 vaccination attitude. Additionally, if the goal is to bolster the actual vaccination intention, the current research indicated that researchers and health communicators could consider focusing on the emotion of relief, for example, presenting evidence that vaccines are not against people's beliefs or values, and effective with limited side effects that can be tolerated.

On a greater scale, the current research provides important implications for future efforts to vaccinate the hesitant. Until now, most Americans who remained unvaccinated against COVID-19 lean Republican (Kates et al., 2022). The current research suggests that there is space to use behavioral interventions to persuade them to get vaccinated, but the strategy needs to be carefully adapted to the features of the unvaccinated population. This resonates with Ho et al.'s (2022) finding that the failure to use conservative narratives (e.g., focusing on authority, purity, loyalty, and religiosity) might partially explain the null results obtained in a recent large-scale field experiment trying to promote COVID-19 vaccination among the hesitant. Therefore, "speak their language" is a potentially effective strategy for the future.

Limitations

The current research has some potential limitations. First, the sample comes from MTurk—a convenient online sample—instead of a nationally representative sample. As indicated in Table S11 in the online supplemental materials, compared with the Republican cohort of the American National Election Studies data (2020; a nationally representative sample), our sample, on average, has a lower age, a higher education level, and a lower annual household income, which are all typical features of MTurk samples (Levay et al., 2016).

Such discrepancies may to some extent limit the generalizability of our conclusions, but we argue that they are not detrimental to the validity of our results. As exploratory analyses, we ran moderation tests (see Table S12a–S12d in the online supplemental materials) to see if income, education, and age significantly moderated any of the treatment effects. Among 30 tests conducted, only three returned significant results, identical to the common α level of 0.1. Given that there is no strong evidence that the treatment effects can vary across demographics, we argue that the conclusions drawn by the current research are valid despite the limitations regarding the demographic representativeness of the samples.

Second, some may argue the key concept of this article—purity/impurity—is more commonly used in the moral psychology domain, yet the research participants might be unfamiliar with the literature and thus could question what "purity" exactly means. However, we argue this is not a severe threat to our conclusions, either. To begin with, more than three-fourths of subjects had shown a non-neutral attitude toward the purity of the COVID-19 vaccine, indicating that comprehension should not be a dominating problem. Additionally, in the present study, we used the standardized language that is most prevalent in the literature. We choose to be loyal to the language used by the literature because failure to stick

to the canonical definitions of purity will likely introduce more “backdoor” mechanisms that may interfere with the main mechanism we are interested in. Therefore, we chose to reiterate the concept of purity in both treatment groups.

In intervention studies, a failure to emphasize the intended intervening construct might introduce noises and confounding mechanisms other than what the researchers intend to test. In our study, we endeavor to center on the purity beliefs yet acknowledge that there might exist “backdoors” that impacted COVID-19 vaccination and intention.

Third, this article only examined COVID-19 vaccination attitudes and intentions, but not real behaviors. Attitude and behavioral intention change could differ from the actual vaccine uptake. Nonetheless, attitudinal and intentional changes are necessary for behavioral change, and they are reliable predictors of actual future behavior (Sheeran, 2002).

Future Research Directions

Building upon the findings of the current research, we propose the following future research directions. First, the current research solely focused on COVID-19 vaccination, but the purity messages and mechanisms can be applied to bolster acceptance of other vaccines or health behaviors.

Second, this article’s treatment focused on the messages about purity, while previous literature has indicated that leveraging information receivers’ shared identity is also effective in health communication. Future research could investigate whether a combination of these perspectives, for example, applying “Republican narratives” from a trusted source in conservative communities, would have a larger effect size in improving the attitudes and intentions of vaccination.

Finally, this article suggests that messages congruent with the moral foundations of receivers may lead to more effective attitude change. This is one side of the coin; simultaneously, it might also be true that misinformation that taps into the receivers’ moral foundations also prompts more negative impacts. Accordingly, future researchers may be interested in examining how the Moral Foundations Theory interacts with misinformation, and thereby design better debunking strategies to control the spread of misinformation.

Conclusion

This article explored the complexity of the relationship between purity moral foundations and COVID-19 vaccination and offered some effective messaging strategies to increase the vaccination intentions of unvaccinated conservatives. It also highlights the importance of applying persuasion strategies consistent with information receivers’ moral foundations.

Resumen

Objetivo: La literatura previa ha indicado una fuerte correlación negativa entre el fundamento moral de pureza/santidad y las tasas de vacunación. La investigación actual investigó cómo las preocupaciones sobre la pureza afectan la vacilación ante la vacunación contra la COVID-19 y probó una intervención de información para reforzar

la intención de vacunación entre las personas con preocupaciones sobre la pureza. **Método:** El estudio 1 encuestó a 566 republicanos e independientes con tendencia republicana en los Estados Unidos. El estudio 2 fue un experimento de encuesta diseñada por sujetos que investigó el impacto de tres declaraciones en las actitudes e intenciones de vacunación contra el COVID-19 de 637 republicanos e independientes con tendencia republicana. La declaración 1 argumentó que las vacunas no son impuras desde una perspectiva científica; la declaración 2 hizo el mismo argumento con citas de la Biblia; y la declaración 3 fue una declaración de control. **Resultados:** El estudio 1 estableció una correlación significativa entre la existencia de antecedentes de vacunación y la pureza como fundamento moral. El estudio 2 encontró que entre aquellos sin antecedentes de vacunación contra el COVID-19, las declaraciones que argumentaban que las vacunas no son impuras desde una perspectiva científica o religiosa mejoraron las actitudes hacia la vacunación y la intención de vacunarse. **Conclusión:** las preocupaciones sobre la pureza pueden aprovecharse como una forma de reforzar las tasas de vacunación, especialmente entre los conservadores. Sin embargo, la percepción de impureza solo medió en la relación causal entre el tratamiento y la actitud hacia las vacunas (pero no la intención real), lo que sugiere que los cambios en el comportamiento de vacunación real están sujetos a factores distintos a las preocupaciones de pureza.

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