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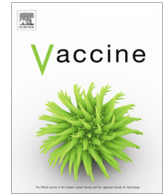
Reminders of existing vaccine mandates increase support for a COVID-19 vaccine mandate: Evidence from a survey experiment

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ABSTRACT

Background: Governments are trying various strategies to boost COVID-19 vaccination rates, including vaccine mandates. Popular support for such mandates, however, is in flux in many countries, including the United States. The objective of this study is to evaluate if the wording of public health messages could increase popular support for COVID-19 vaccine mandates.
Methods: We conducted a survey experiment on a sample of 573 registered voters in South Dakota, United States. Participants in the control group (n = 271) read a short message about mandatory COVID-19 vaccination. Respondents in the treatment group (n = 278) read the same message but they were reminded that a variety of vaccine mandates for measles, mumps, rubella, and polio have long been required. Afterwards, both groups were asked about their support for COVID-19 vaccine mandate.
Results: A multivariate ordinary least squares regression analysis revealed that the experimental treatment had a positive and statistically significant impact on support for mandatory COVID-19 vaccination ($p < 0.001$). We also found that COVID-19 vaccination status, religious identity, and political affiliation have a statistically significant effect.
Conclusions: Our findings suggest that a simple intervention—reminding the public of the existing vaccine mandates—increases support for COVID-19 vaccine mandate. Public health authorities who seek to boost COVID-19 vaccination rates could utilize this approach.

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1. Introduction

In March 2020, the World Health Organization declared the novel coronavirus (COVID-19) outbreak a global pandemic. As of April 2022, there have been roughly 485 million confirmed cases, with over five million deaths worldwide. The number of COVID-19 deaths in the United States is approaching one million, which is more than any other country [1]. While governments have used various approaches to curb the spread of the COVID-19 virus, such as reduction of mobility and mask mandates, experts consider vaccination the most effective tool. Vaccinating a substantial portion of the global population constitutes the greatest challenge in bringing the COVID-19 pandemic under control.

In the United States, multiple vaccines have been available to the public at no cost since December 2020. Nevertheless, the pace of vaccination has slowed down, and as of April 2022, only 66 % of eligible Americans are fully vaccinated. Clearly, large segments of the US population have been expressing strong vaccine hesitancy. With the prevalence of highly contagious omicron virus strain,

there is a concern that the pandemic will be prolonged, leading to further casualties and massive strain on the health care system.

Given the severity of the pandemic, the US government is considering various forms of COVID-19 mandates to increase vaccination rates. Some experts consider the implementation of a vaccine mandate an integral step in reaching herd immunity against the virus [2]. Evidence from previous vaccination campaigns, such as hepatitis and varicella vaccination campaigns, points out that vaccine mandates effectively increase vaccination rates [3,4]. Multiple countries, such as Fiji, Canada, Italy and the United States, have already passed COVID-19 vaccine mandates for some population groups, such as civil servants, health care workers, or military personnel. Turkmenistan and Micronesia have even made COVID-19 vaccination mandatory for all residents aged 18 and older. Austria passed a similar mandate but it was never put into effect and the government suspended it.

Given that a vaccine mandate is more restrictive than existing approaches to increase vaccination, such as recommendations from doctors or monetary rewards, it has attracted controversy. Some experts expressed a strong opposition to a COVID-19 vaccine mandate and argued that it would actually reduce vaccine uptake [5,6]. A recent study suggested that the presence of a vaccine

mandate was linked to lower interest in receiving a COVID-19 vaccination [7]. Forcing people to be vaccinated could have negative downstream consequences, such as increase in societal tensions [8] and contestation between political parties to varying extents [9,10].

Recent empirical studies uncovered varying levels of popular support for a COVID-19 mandate. A study conducted in Germany found that about half of the population supported such a policy [11], while a study from France found that 43 % of the participants were in favor while 41 % opposed mandatory COVID-19 vaccination policy [12]. Public support for mandatory vaccination in the United States is mixed, but it appears to be increasing. According to a nation-wide survey conducted in June and July 2021, the overall support for a general vaccine mandate in the United States was 64 % [13]. The survey uncovered large partisan divisions within the United States, with Democrats being twice as likely to support COVID-19 vaccine mandate than Republicans. Overall, it is not clear how the public would react to a COVID-19 vaccine mandate and how much opposition it would galvanize.

In the present study, we propose and then evaluate a novel behavioral intervention to boost popular support for a COVID-19 vaccine mandate. We build upon findings from social and behavioral sciences on the impact of framing effects on individual choice across a range of behaviors [14]. Scholars believe that these insights could help develop interventions to bring the COVID-19 pandemic under control [15,16]. Existing scholarship found that even small changes in the wording of messages encouraging COVID-19 vaccination can affect willingness to receive a vaccine [17,18]. For example, one recently published study found that "messages emphasizing the personal health risks and collective health consequences of not vaccinating significantly increase Americans' intentions to vaccinate" [19].

We believe that a similar mechanism might be in place when it comes to support for COVID-19 vaccine mandates. More specifically, reminding the public of existing vaccine mandates might boost popular support for a COVID-19 vaccine mandate. In the United States, several vaccines have been required since the 19th century and current mandates that have been in effect for decades include measles, mumps, rubella (MMR); polio, diphtheria, tetanus, and acellular pertussis (DTaP); and chickenpox vaccine mandates [20]. These mandates are enforced when parents register children for school attendance. Given the federal structure of the government, there is no single vaccination policy and variations exist, such as the presence of exemptions for religious or philosophical reasons [21,22]. Yet, the policies are very similar between states, thus exposing residents of the United States to vaccination and the concept of mandatory vaccination at a young age. Virtually all adults in the United States, including those who have not received a COVID-19 vaccine and who oppose mandatory COVID-19 vaccination, have received MMR and polio vaccinations in their lives. We therefore hypothesize that reminding people of the existing MMR and polio mandates would increase their support for a COVID-19 vaccine mandate. We also believe that this intervention could have similar effects in societies around the world that have similarly structured vaccination requirements for their youth [23].

2. Methods

2.1. Sample and procedures

To evaluate our expectations, we conducted a survey experiment from July 31 to August 13, 2021 using a sample of 573 registered voters in South Dakota, a state with a relatively low COVID-19 vaccination rate. The experiment was part of a larger survey on the impact of the COVID-19 pandemic on families in South Dakota.

Utilizing registration based sampling [24], a group of 12,000 randomly selected registered voters in the state received a letter of invitation to complete an online survey through the *QuestionPro* survey platform. The response rate was 4.78 %, which is on par with similar statewide surveys [24]. While generally representative of the state, the sample skews a bit older than the population as an artifact of the sampling method—voter registration rates are lower amongst younger residents. For the same reason, the rate of COVID-19 vaccination is higher in the sample than in the general population. To correct for these imbalances, we use entropy balancing to weight the sample by gender, age cohorts (using census data), region within the state, COVID-19 vaccination status, and political party affiliation towards population parameters [25].

2.2. Experimental design

Participants were randomly assigned to two groups—a control group and a treatment group. Participants in the control group (n = 271) read a short message about the recent debate regarding mandatory COVID-19 vaccination. Subjects in the treatment group (n = 278) read the same message, but they were also reminded that vaccine mandates for measles, mumps, rubella, and polio have long been required by public health authorities (Appendix Part C). After reading a message, participants in both groups answered the same question on support for mandatory COVID-19 vaccination. Table 1 shows that the demographic characteristics between the treatment and control groups are very similar.

2.3. Measures

Support for mandatory COVID-19 vaccination was measured with a single question "Overall, how supportive are you of the idea of mandatory COVID-19 vaccination for all adults, except for medical or religious exemptions?" (1= "strongly opposed" − 5= "very supportive"). Participants were asked a standard set of demographic questions in the first question block including gender, age, evangelical identity, and COVID-19 vaccination status (Appendix Part C). Given the political nature of the COVID-19 pandemic, we also included partisan identification questions in the survey. An instructional manipulation check question was also included, which 98.3 % participants answered correctly.

2.4. Statistical analysis

We employ multiple methods of analysis to assess whether a reminder of existing vaccination mandates will make respondents more receptive to a proposed mandate for COVID-19. First, we conduct a difference of means test (using a *t*-test) between the control and treatment groups. A statistically significant difference would provide support for our hypothesis. Additionally, sub-group analysis (by *t*-test) is conducted in populations that the extant literature shows to be most receptive to COVID-19 vaccination—those 60 years or older, Democrats, and non-evangelicals, and those who are more resistant—evangelicals, Republicans, and men. Such analysis can highlight which population groups are most receptive or resistant to the experimental treatment.

Finally, to control for potentially confounding effects of a variety of other factors, we also estimate an ordinary least squares regression, using the question of support for mandatory vaccination as the dependent variable and the experimental treatment as the primary independent variable. Significance of the treatment variable would again lend empirical support to the hypothesis. Guided by the extant research on COVID-19 policy attitudes, we include binary indicators for a respondent's vaccination status, partisan self-identification (Democrat or Republican with independents as the reference group), male identification, evangelical

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Table 1
Descriptive statistics of dependent and independent variables.

Dependent Variable: Support for COVID-19 Vaccine Mandate						
			Frequency			Percent
Strongly Opposed			165			30.05
Somewhat Opposed			50			8.11
Not Sure			27			4.92
Somewhat Supportive			70			12.75
Very Supportive			237			43.17
	Total		Control Group		Treatment Group	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Men	261	45.71	127	46.86	122	43.88
Evangelical	124	26.38	58	25.89	64	27.47
Democrat	143	26.63	64	23.88	79	29.37
Republican	223	41.53	115	42.91	108	40.15
Vaccinated	437	80.18	216	80.30	218	79.85
	Mean	SD	Mean	SD	Mean	SD
Age	56.60	16.49	56.02	16.42	56.79	16.64

Note: Some respondents dropped out of the survey before being assigned to control or treatment groups.

identification, alongside age (in years) as controls in the model [11–13,26]. All analyses is conducted in Stata 17.
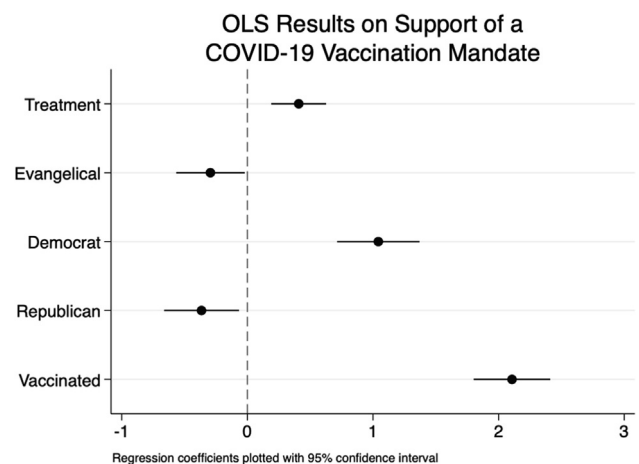
3. Results

The results of a *t*-test show that the mean for respondents in the treatment condition is 3.0 and the control group is 2.7 on a 5-point scale. However, the p-value fell short of standard threshold of two-tailed statistical significance ($p = 0.103$). Thus, our hypothesis (that hearing a reminder of existing vaccines increase support for a COVID-19 vaccine mandate) fails the initial test. However, sub-group analysis results presented in Table 2 show that certain subsets of the population are responsive to this priming effect. Amongst non-evangelical respondents the treatment group mean support was 3.3 and control mean was 2.7 ($p = 0.013$). Conversely, evangelicals show no significant response to the treatment. Respondents 60 years and over were quite receptive to this messaging with statistically significant difference in means of 3.8 and 3.2 between treatment and control ($p = 0.015$). Unsurprisingly, those already vaccinated are also moved towards a pro-mandate position with means of 4.2 and 3.6 ($p < 0.001$). The t-tests amongst men, women, and both partisan groups were non-significant.

The results of the OLS regression, which are visually displayed in Fig. 1, are largely congruent with the results of the difference in means tests and provide strong evidence for the hypothesis. We provide the regression parameters in Table S1 in the appendix. After controlling for political affiliation and COVID-19 vaccination status, the experimental treatment variable is statistically significant in the predicted direction, passing the strongest standard significance test ($p < 0.001$). Using the regression parameters to predict the level of support for a vaccine mandate, the net effect

Table 2
Difference of Means Test: Sub-Group Analysis.

	Control	Treatment	Difference
All Respondents	2.71	3.02	0.31
Evangelicals	1.90	2.19	0.29
Non-Evangelicals	2.67	3.29	0.62*
Age 60 or Greater	3.24	3.82	0.58*
Vaccinated	3.62	4.18	0.56***
Men	2.52	3.04	0.52
Women	2.92	3.01	0.09
Democrats	4.29	4.51	0.22
Republicans	1.87	2.13	0.26

p|t| < 0.05 two-tailed *; p|t| < 0.001 two-tailed ***.

Fig. 1. OLS Results for Support for a COVID-19 Vaccine Mandate.

of the treatment is a 9.8 % increase in the value of the dependent variable across the entire sample (relative to the baseline of the control group). In other words, the support for a COVID-19 vaccine mandates is greater by 9.8 % among the treatment group participants compared to the control group participants.

It is immediately apparent that the effect of the treatment towards opinions on a vaccine mandate is stronger than the effects of identifying as a Republican (relative to independents) or evangelical Christian (relative to non-evangelicals), albeit in the opposite direction. Both of these variables have been shown to strongly correlate with many attitudes on COVID-19 mitigation practices. Holding other factors constant, the treatment largely offsets the effects of Republican or evangelical identity. It is also apparent, both in the visualization and from the coefficients, that the net effect of the treatment is less than Democratic partisan identification and COVID-19 vaccination status. This finding reinforces the fact that attitudes on COVID-19 mitigation policies are driven by a multitude of factors. The results for gender and age are not statistically significant.

To test the reliability of our results, we perform several robustness checks and report the results in the Appendix. First, we conduct a simple bivariate regression with the experimental treatment as the single independent variable. The results show similar values of the treatment coefficient and its p-value (Table S2). Second, we estimate OLS regressions with unweighted

data (Table S3) and find very similar results as our weighted model; with the unweighted model showing a slightly stronger treatment effect. Third, given that our dependent variable is ordinal, we also estimate an ordered logistic regression (Table S4). The results, in terms of statistical significance, direction, and substantive effect of the treatment are very similar to the OLS estimates. We report the results of the OLS regression for ease of interpretation of the linear coefficients. We also include a correlation matrix that shows low levels of correlation amongst explanatory variables in the appendix (Table S5).

4. Discussion

Vaccinating a substantial portion of the population is considered the key to bringing the COVID-19 pandemic under control. Nevertheless, despite a wide availability of COVID-19 vaccines at no cost to patients, countries like the United States have been struggling to reach this goal. Given that encouragements and incentives have not been very successful, governments are increasingly considering COVID-19 vaccine mandates to increase the number of vaccinated people. Given the restrictive nature of this policy, experts have been concerned about the potential opposition and the impact on society. The results of this study show that a relatively simple intervention—reminding people of existing vaccine mandates—can increase support for a COVID-19 vaccine mandate and ameliorate some of these concerns. In doing so, we demonstrate that findings from behavioral sciences can be harnessed to devise effective interventions that could be applied to COVID-19 related attitudes and behaviors. Scholars have shown that small changes in wording of messages can increase vaccine uptake. Here, we build upon this scholarship and provide evidence that the same mechanism applies to attitudes towards a COVID-19 vaccine mandate.

We hope that governmental and public health officials will find the results of this study useful. In the United States, the federal government requires COVID-19 vaccination for health care workers and military personnel. Some states, such as California and New Jersey also mandate COVID-19 vaccination for state government workers and educational workers. The results of this study might help in communication with the public and in public health campaigns that seek to boost support for a general COVID-19 vaccine mandate in the United States. Our results suggest that some groups are very likely to be receptive to such campaigns. On the other hand, given the firm opposition among other groups, it is not clear if any kind of intervention would be able to move the opinions of the most vaccine-resistant population towards a COVID-19 vaccine mandate.

The finding that reminders of existing vaccine mandates should increase support for COVID-19 vaccine mandate has implications beyond South Dakota and the United States. We expect to observe a similar effect in countries that have vaccine mandates for school-age children in place. According to a recent estimate, over 100 countries and territories around the world have vaccine mandates or require at least one vaccine for school attendance [23]. Political leaders and public health officials in these countries who are considering a COVID-19 vaccine mandate might be able to use the intervention that we proposed to increase public's support for a COVID-19 vaccine mandate.

For example, in Slovakia only 51 % of the eligible population has been vaccinated as of April 2022, which is why the government has been considering adopting a COVID-19 vaccine mandate [27]. However, only 39 % residents of Slovakia support such a policy according to a poll conducted in December 2021 [28]. At the same time, Slovakia has existing mandates for vaccination against 10 diseases, including polio, Diphtheria, and mumps [29]. The intervention we evaluate could be utilized in countries, such as Slovakia, to make mandatory COVID-19 vaccination more acceptable to the general public.

Despite the many contributions, this study is not without limitations. Participants in this study were only from South Dakota, which is more rural, more religious, and more politically conservative than the rest of the United States. Nevertheless, South Dakota is an ideal population from which to draw a sample for our experiment. In many respects, the state offers a "least likely" case, where the population's preferences are biased against support of a vaccine mandate. It has relatively low levels of COVID-19 vaccination in the United States—47 % of South Dakotans were fully vaccinated at the time of fielding the survey, compared to 52 % Americans [30]. A sizable proportion of South Dakotans are rather vaccine resistant [31]. Additionally, pro-vaccination messaging from political figures has been rather muted; and executive orders have been issued explicitly banning COVID-19 "vaccine passports" and COVID-19 vaccine mandates by any state or local authorities [32].

The timing of our study allowed us to maximize leverage on the impact of our intervention. At the time of the survey, COVID-19 positive cases were extremely low in South Dakota (South Dakota experienced the delta wave later than other states), which introduces additional bias against our results. With the number of cases at a relative nadir, we would expect the people to be less concerned about the pandemic and thus be more resistant to messaging regrading support for COVID-19 vaccine mandates. The presence of statistically significant results at the point of low health risk highlights the impact of our intervention.

In the future, scholars may wish to replicate and extend this study on a broader scale. Scholars could also investigate if certain messengers are more likely to increase public's support for a COVID-19 vaccine mandate. Evidence suggests that messaging from religious [33] and political leaders [34] can increase people's favorable attitudes towards receiving a COVID-19 vaccine. It is plausible that if these same leaders delivered a carefully crafted message that reminded people of existing vaccine mandates, the public's attitude towards a COVID-19 vaccine mandate might become even more favorable.

CRediT authorship contribution statement

F. Viskupič: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – Original Draft, Writing – Review & Editing. **D.L. Wiltse:** Data Curation, Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – Original Draft, Writing – Review & Editing. **A. Badahdah:** Methodology, Writing – Review & Editing.

Data statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2022.08.014.

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