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Comparing the influence of intellectual humility, religiosity, and political conservatism on vaccine attitudes in the United States, Canada, and the United Kingdom

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Abstract

Three studies of US, Canada, and UK respondents examined pro-vaccine attitudes as predicted by intellectual humility, belief in science, religiosity, and political attitudes. Intellectual humility refers to the capacity to understand limits of one's own beliefs and showed strong relationship to pro-vaccine attitudes across samples. Pro-vaccine attitudes were correlated with intellectual humility and negatively correlated with political conservatism and religiosity. Regression models compared overlapping influences of belief predictors on vaccine attitudes. Across countries, intellectual humility was the most consistent predictor of pro-vaccine attitudes when controlling for other beliefs and thinking styles (political conservatism, belief in science, religiosity). In comparison, political conservatism was a significant predictor of vaccine attitudes in regression models on US and Canadian respondents, and religiosity only held as a predictor in regression models in the US sample. We conclude with a discussion of intellectual humility as a predictor of vaccine attitudes and implications for research and persuasion.

Keywords

intellectual humility, political attitudes, religious belief, science attitudes, vaccine attitudes

Vaccines have been heralded as one the greatest breakthroughs in medical science, and with good reason. Immunization programs have been shown to be effective against a variety of infectious diseases that once plagued humankind, including polio, measles, and smallpox. But incredibly, the greatest impediment to mass vaccination in wealthy nations is neither availability nor distribution of vaccines, but the public's own resistance to vaccination. Vaccine hesitancy has risen sharply in the last 20 years (Dubé et al., 2015), resulting in outbreaks of diseases thought vanquished, such as measles (McHale et al., 2016). In the ongoing covid-19 pandemic, anti-vaccine attitudes presented a major public health problem by creating barriers to herd immunity, allowing opportunity for

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more variants to develop, and with unvaccinated patients accounting for the majority of hospitalizations and deaths since vaccines have become widely available (Hippisley-Cox et al., 2021).

It seems then our biggest challenge regarding vaccination is not the understanding of human biology, but understanding of human psychology: Why are so many people defiantly opposed to vaccines that could save their lives? The present cross-country research examines different kinds of beliefs and thinking styles expected to influence vaccine hesitancy, namely political attitudes, religious beliefs, support for science, and intellectual humility. Each of these beliefs may influence vaccine attitudes via associated skepticism or openness to vaccine issues.

Role of Intellectual Humility

Of special interest here is Intellectual Humility (IH), an individual difference in understanding the limits to one's knowledge, and a willingness to accept the possibility of alternatives and update existing beliefs when necessary (Davis et al., 2016). IH has gained recent attention as an intellectual trait associated with cognitive characteristics that promote learning and broadened thinking (Krumrei-Mancuso et al., 2020), including greater need for cognition, curiosity, and intellectual openness. Central to IH is an appreciation that one's own knowledge may be limited (Davis et al., 2016) without this posing a personal threat to the ego (Krumrei-Mancuso and Rouse, 2016). For instance, when presented with new ideas, intellectually humble people show better cognitive flexibility (Zmigrod et al., 2019) and tolerance of ambiguity (Leary et al., 2017). IH may also promote openness toward opposing ideas, including contrary religious beliefs (Hook et al., 2017; Rodriguez et al., 2019) and political views (Porter and Schumann, 2018). In other words, intellectually humble people are less defensive and arrogant about their beliefs, show more respect for alternative views, and are more willing to revise attitudes when given good evidence.

IH can also directly relate to vaccination attitudes (Huynh and Senger, 2021). At a basic level, the decision to get vaccinated requires deference to others' knowledge and expertise, and this is only possible if one accepts their own lack of expertise in the matter. At the same time, widespread misinformation surrounding vaccination effectiveness and risks means that laypeople must also be able to discern good advice from bad advice. This requires an additional layer of self-imposed objectivity in evaluating the credibility of evidence, and resistance to confirmation biases that justify pre-existing beliefs and fears. Again this is only possible if one is willing to critically evaluate own beliefs based on evidence and update those beliefs when appropriate, all elements of IH.

IH may also explain the relationship of other beliefs to vaccine attitudes. Anti-vaccine attitudes are related to mistrust of authoritative information sources, such as the government (Jamison et al., 2019) and scientists (Rutjens et al., 2022; Sanchez and Dunning, 2021), and shown to relate to belief systems such as religiosity (Corcoran et al., 2021) and political conservatism (Hornsey et al., 2020), beliefs which tend to be shared and fostered within groups as a common value system. IH is essential for scientific thinking and respect for scientific expertise, as these require openness to others' knowledge and willingness to be informed by others. Religious attitudes are argued to affect vaccination attitudes in Americans through certain underlying moral and philosophical beliefs (e.g. that ultimately God controls health outcomes; Kuru et al., 2022). But notably, religiosity is also linked to lower IH (Krumrei-Mancuso, 2018), which could potentially explain anti-vaccine attitudes among religious people. Political conservatism is also related to vaccine hesitancy (Hornsey et al., 2020; Kossowska et al., 2021), but this too may be confounded with differences in IH. Vaccination has become a politically polarized issue in the wake of the covid-19 pandemic, especially in the United States and Canada (Pennycook et al., 2020). So people unable to approach those perspectives with some IH may become closed to opposing political views on vaccines. In a

study with American participants, vaccine hesitancy was related to moral concerns for liberty (Amin et al., 2017), which may relate to the resistance to control from others' ideas found in those with low IH.

Present studies

Three studies here investigate the role of individuals' beliefs and thinking styles, that is, religiosity, political ideology, belief in science, and IH on pro-vaccine attitudes, with special attention to differences in IH as a predictor. Senger and Huynh (2021) examined the contribution of IH in predicting vaccine attitudes in a study of American respondents, using a regression model that included demographic variables such as political attitudes, age, ethnicity, and socioeconomic status. We similarly use regression modeling to explore IH and other beliefs that may overlap with IH, that is, belief in science, religiosity, and political attitudes. These variables have been shown in other studies to correlate with vaccine attitudes and with each other, and so we examine their unique and shared effects as predictors of vaccine attitudes.

This research examined vaccine attitudes in three different Western countries (the United States, Canada, and the United Kingdom), to consider national variations with religion and political ideology. These countries were selected for their key cultural similarities and differences relevant here. In addition to being "WEIRD" cultures (Henrich et al., 2010), the three nations have a shared history and many shared cultural norms. All three nations have benefited from large-scale covid-19 vaccination programs heavily supported by the government, and widespread vaccination against other diseases prior to the covid-19 pandemic. But there are a few notable differences between these nations. Though all are predominantly Christian in religious affiliation, religiosity is more important to Americans compared to either British people or Canadians (Pew Research Center, 2021). All three countries use democratic elections with varied political views among their citizens, but differed in the governing political party during the covid-19 pandemic (and thus the party responsible for issuing vaccine advice). Canada had a Liberal federal government in power throughout the pandemic, while the United Kingdom had a Conservative government. Meanwhile, the United States began the pandemic with a Republican president and congress, but power shifted to the Democrat party at the end of 2020, as covid-19 vaccines were first becoming publicly available. Vaccine attitudes can also be impacted by trust in the government (Jamison et al., 2019). Comparing the role of political ideology in these countries can shed light on how general political ideology and trust in the government shape vaccination attitudes (see also Pennycook et al., 2020). Whereas much other work on vaccine attitudes has focused exclusively on American populations (e.g. Senger and Huynh, 2021), we take a cross-country approach to compare the relative influence of these beliefs in different cultural environments.

In three studies we measured vaccine attitudes as predicted by IH, belief in science, religiosity, and political ideology, using samples in the United States, Canada, and the United Kingdom. Belief in science as a way of knowing is directly relevant to vaccine attitudes and so was expected to correlate to pro-vaccine attitudes in all countries. Effects of religiosity and political ideology were expected to vary depending on country. General religiosity was expected to have strongest relationships with anti-vaccine attitudes in the United States, compared to Canada or the United Kingdom. Political conservatism was expected to predict negative vaccine attitudes in the United States and Canada—where there has been vocal opposition to vaccines by conservative political groups. But this relationship is expected to be weaker in the United Kingdom, where a conservative government has overseen a largely successful vaccine campaign. But our primary interest was in IH, expected to emerge as a consistent predictor of pro-vaccine attitudes in all three nations.

US study

Method

Participants. To observe moderate-sized correlations of $r = .30$, and medium-sized effect (Cohen's $f^2 = .15$) in multiple regression with four predictors, at least 85 participants would be needed to achieve 80% power[1] (Soper, 2023). We aimed to collect sample sizes around 100 participants per study in line with these estimates. One hundred seventeen American participants were recruited from Amazon MTurk for a small payment and completed the online survey on 25 August 2021. All participants showed location in the United States and confirmed they presently lived in the United States. Eighteen participants failed the attention check, and five responses were omitted for duplicate IP addresses, leaving 93 responses in the data set (66 men, 27 women, 1 non-reporting, $M_{age} = 37.5$ years, $SD = 12$).

Materials and design. Participants responded to an online survey on various attitudes. Unless otherwise indicated, all measures were on a 7-point Likert-type scale with endpoints 1 = strongly disagree, 7 = strongly agree. General religiosity (e.g. "*I consider myself a religious person*") was measured with a 7-item scale ($\alpha = .98$). IH was measured using the 22-item IH scale (Krumrei-Mancuso and Rouse, 2016, $\alpha = .87$). A 5-item Belief in Science Scale (BIS; adapted from Farias et al., 2013), measured belief in science as the best way of knowing, for example, "*Science provides us with the best understanding of the universe*" ($\alpha = .94$). An attention measure was included with a single item "*If you are paying attention do not answer this question*" (1–7 scale). Pro-Vaccine attitudes (e.g. "*Widespread vaccination coverage of the population is important in order to avoid new epidemics of old diseases*") were measured on a 13-item scale ($\alpha = .92$). Items were taken using a modified version of Cvjetkovic et al. (2017) to assess general attitudes toward disease vaccination, and we added a question on covid-vaccine attitudes: "*To what extent have you been reluctant to get the covid-19 vaccine?*" (reverse-scored). Finally, a demographic questionnaire at the end of the study asked gender, religious affiliation, political attitudes (1 = strongly liberal, 7 = strongly conservative), age, and country of residence. See measures used at: https://osf.io/cyduk/?view_only=5a5d3453f7df47ae90df6ce024e283b2

Note on IH scale. As noted, we used the 22-item IH scale developed by Krumrei-Mancuso and Rouse (2016). This scale consists of four facet subscales. First, Independence of Intellect and Ego refers to a capacity to view challenges to ideas non-threateningly (e.g. "*I feel small when others disagree with me on topics that are close to my heart*"). Second, Openness to Revising One's Viewpoint is a willingness to change opinion when given good alternative evidence (e.g. "*I am willing to change my opinions on the basis of compelling reason*." Third, Respect for Other's Viewpoints refers to basic respect for others with different ideas (e.g. "*I am willing to hear others out, even if I disagree with them*"). Finally, Lack of Intellectual Overconfidence is a non-arrogant view of one's own ideas (e.g. "*On important topics, I am not likely to be swayed by the viewpoints of others*"). Notably, all items on Facets 2 and 3 are worded with a positive framing, whereas items for Facets 1 and 4 are worded with the negative framing. In calculating the total IH scale, items for Facets 1 and 4 are reverse-scored so that the scale reflects more positive IH.

Results and discussion

Data and online materials for all studies can be found here: https://osf.io/cyduk/?view_only=5a5d3453f7df47ae90df6ce024e283b2.

Table 1 displays zero-order correlations between the main predictors (IH, BIS, religiosity, and political conservatism) and pro-vaccine attitudes for all studies. For brevity we do not report all

Table 1. Zero-order correlations between pro-vaccine attitudes and belief predictors (intellectual humility, belief in science, religiosity, political conservatism), by country.

	Pro-vaccine attitudes		
Predictors	US ($N = 93$)	Canada ($N = 96$)	UK ($N = 94$)
Intellectual humility	.52**	.29**	.34**
Belief in science	.18	.32**	.17
Religiosity	−.63**	−.25*	−.21*
Political conservatism	−.51**	−.38**	−.22*

*$p < .05$; **$p < .01$.

bivariate correlations, but these may be found in the supplemental materials. Pro-vaccine attitudes were positively related to IH ($r = .52$, $p < .001$) and negatively related to religiosity ($r = -.63$, $p < .001$) and political conservatism ($r = -.51$, $p < .001$), see Table 1.

Multiple regression examined overlapping and unique effects of predictor beliefs on pro-vaccine attitudes. In Model 1, all belief-related predictors (IH, BIS, religiosity, political conservatism) were entered together in the regression (confidence intervals (95%) for regression model are presented in brackets). IH,[2] religiosity, and political conservatism remained significant in the regression model, but BIS was not: IH ($b = 0.54$ (0.25, 0.83), $t = 3.73$, $p < 0.01$), religiosity ($b = -0.19$ (−0.32, −0.6), $t = -2.01$, $p < 0.05$), BIS ($b = 0.15$ (−0.01, 0.30), $t = 1.91$, $p = .06$), and political conservatism ($b = -0.16$ (−0.27, −0.08), $t = -3.53$, $p = .001$). See results in Table 2.

A second regression model included all belief-related predictors, plus age (continuous), and gender (1 = male/ 2 = female)[3] as demographic variables. Confidence intervals (95%) for regression model are presented in brackets. IH ($b = 0.54$ (0.25, 0.84), $t = 3.71$, $p < 0.001$), religiosity ($b = -0.17$ (−0.30, −0.03), $t = -2.45$, $p = .016$), and political conservatism ($b = -0.21$ (−0.31, −0.10), $t = -4.00$, $p < 0.001$) all remained significant in the regression model. BIS was also significant in the model ($b = 0.17$ (−0.01, 0.33), $t = 2.17$, $p = .033$). Neither gender ($b = 0.38$ (−0.01, 0.03), $t = -1.64$, $p = .11$) nor age ($b = 0.01$ (−0.01, 0.03), $t = 1.27$, $p = .21$) had a significant effect on the regression.[4]

Summary. In a US sample, pro-vaccine attitudes were predicted by greater IH, lower religiosity, and lower political conservatism. Moreover, these effects remained significant when controlling for each other in a multiple regression model. These results suggest robust and independent influences of these variables to predict pro-vaccine attitudes in an American sample.

Canada study

Method

Participants. One hundred six Canadian participants were recruited from Amazon MTurk between dates of 10 and 11 September 2021 for a small payment. All participants showed location in Canada and confirmed they presently lived in Canada. All participants passed the attention check, but 10 responses were omitted for duplicate IP addresses, leaving 96 responses in the data set (59 men, 37 women, $M_{age} = 36.8$ years, $SD = 10.3$).

Materials and design. Participants responded to a survey on various attitudes. Scales used were same as in Study 1 for general religiosity ($\alpha = .97$), BIS ($\alpha = .92$), IH ($\alpha = .88$), and pro-vaccine attitudes ($\alpha = .94$). Responses were taken during a Canadian federal election campaign, and participants were asked which party they intended to support in the upcoming election.

Table 2. Linear regression Model 1, predicting pro-vaccine attitudes from predictors (intellectual humility, belief in science, religiosity, political conservatism), by country.

	Linear regression (Model 1) by country					
	US ($N=93$)		Canada ($N=96$)		UK ($N=94$)	
Predictors	B	[95% CI]	B	[95% CI]	B	[95% CI]
IH	0.54**	[0.25, 0.83]	0.31*	[0.01, 0.60]	0.52**	[0.16, 0.88]
BIS	0.15	[0.01, 0.30]	0.13	[−0.07, 0.33]	0.09	[−0.11, 0.29]
Religiosity	−0.19*	[−0.32, −0.06]	−0.01	[−0.15, 0.13]	−0.02	[−0.15, 0.11]
Conservatism	−0.16**	[−0.27, −0.08]	−0.17*	[−0.30, −0.04]	−0.11	[−0.26, 0.05]

IH: intellectual humility; BIS: Belief in Science Scale.
*$p<.05$; **$p<.01$.

Results and discussion

In zero-order correlations, pro-vaccine attitudes were positively related to IH ($r=.29$, $p=.004$) and BIS ($r=.21$, $p=.001$) and negatively related to religiosity ($r=-.25$ $p=.015$) and political conservatism ($r=-.38$, $p<.001$), see Table 1. Multiple linear regression tested the overlapping and unique effects of all belief predictors (IH, BIS, religiosity, political ideology) on pro-vaccine attitude; only IH and political conservatism remained significant in the model.[5] Confidence intervals (95%) for regression model are presented in brackets: IH ($b=0.31$ (0.01, 0.60), $t=2.06$, $p=.04$), political conservatism ($b=-0.17$ (−0.30, −0.04), $t=-2.55$, $p=.012$), religiosity ($b=-0.01$ (−0.15, 0.13), $t=-0.16$, $p=.87$), BIS ($b=0.13$ (−0.07, 0.33), $t=1.26$, $p=.21$), see Table 2.

Model 2 added age (continuous) and gender (1 = male/2 = female) as demographic variables in the linear regression. IH and political conservatism both remained significant in the model: IH ($b=0.33$ (0.04, 0.63), $t=2.25$, $p=.027$), political conservatism ($b=-0.16$ (−0.30, −0.03), $t=-2.43$, $p=.017$), while religiosity ($b=-0.02$ (−0.16, 0.11), $t=-0.35$, $p=.73$) and BIS ($b=0.12$ (−0.09, 0.32), $t=1.15$, $p=.25$) both remained non-significant in the model. Finally, neither gender ($b=0.20$ (−0.64, 0.25), $t=-0.88$, $p=.38$) nor age ($b=0.00$ (−0.02, 0.02), $t=0.17$, $p=.87$) had a significant effect in the regression.

Summary. In a Canadian sample, pro-vaccine attitudes were predicted by greater IH and BIS, and by lower religiosity and political conservatism. But only the effects of IH and political conservatism remained significant predictors when controlling for all other predictors in a multiple regression model.

UK study

Method

Participants. Ninety-four UK participants (48 men, 46 women, $M_{age}=36.5$ years, $SD=10.7$) were recruited for a small payment from Amazon MTurk, between dates of 1 and 9 November 2021.

Materials and design. Participants responded to a survey on various attitudes. Scales used were same as in Studies 1 and 2 for religiosity ($\alpha=.96$), BIS ($\alpha=.88$), IH ($\alpha=.87$), and vaccine attitudes ($\alpha=.93$). Participants were also asked which political party, if any, they voted for in the previous election.

Results

In zero-order correlations, pro-vaccine attitudes in the UK sample were positively related to IH ($r = .34$, $p < .001$) and negatively related to political conservatism ($r = -.21$, $p = .004$) and religiosity ($r = .22$, $p = .004$), but not correlated with BIS ($r = .29$, $p = .10$), see Table 1. Multiple regression was used to examine overlapping and unique effects of these predictors on vaccine attitudes, see Table 2. All predictor variables were entered together in the regression (total adjusted $R^2 = .11$, $F(4, 88) = 3.93$, Model $p = .006$). Only IH was significant in the model.[6] Confidence intervals (95%) for the regression model are presented in brackets: IH ($b = 0.52$ (0.16, 0.88), $t = 2.89$, $p = .005$), religiosity ($b = -0.02$ (−0.15, 0.11), $t = -0.35$, $p = .73$), BIS ($b = 0.09$ (−0.11, 0.29), $t = 0.91$, $p = .36$), and political conservatism ($b = -0.11$ (−0.26, 0.05), $t = -1.35$, $p = .18$).

Model 2 added age (continuous) and gender (1 = male/2 = female) as demographic variables in the linear regression (confidence intervals (95%) are presented in brackets). IH remained significant in Model 2 ($b = 0.47$ (0.11, 0.84), $t = 2.57$, $p = .012$). Political conservatism ($b = -0.11$ (−0.27, 0.05), $t = -1.37$, $p = .17$), religiosity ($b = -0.02$ (−0.16, 0.11), $t = -0.34$, $p = .73$), and BIS ($b = 0.07$ (−0.14, 0.28), $t = 0.64$, $p = .52$) were all non-significant in the model. Neither gender ($b = -0.24$ (−0.75, 0.26), $t = -0.96$, $p = .34$) nor age ($b = 0.01$ (−0.02, 0.03), $t = 0.41$, $p = .69$) had a significant effect in the regression.

Summary. In a UK sample, pro-vaccine attitudes were predicted by higher IH, lower religiosity, and lower political conservatism. But only IH remained a significant predictor when all factors were entered in a multiple regression model.

General discussion

Public sentiment toward vaccines has shifted in recent years, and growing divisions between those for and against vaccines may pose serious public health issues. We address this growing health issue by examining the beliefs thought to influence vaccine attitudes, including religion, politics, support for science, and IH. IH emerged as the most consistent overall predictor across studies in three Western nations (United States, Canada, and United Kingdom), compared to differences in religiosity and political ideology. At its core, IH is an approach to one's beliefs and can therefore affect factors such as willingness to listen to experts (e.g. doctors) and resistance to ideas from uncredible sources. Unlike political and religious beliefs (and arguably belief in science), IH does not have clear ingroup–outgroup divisions, and so is not subject to the same cultural tribalism as religious and political attitudes. Indeed, IH may be a better predictor of vaccine attitudes than either religiosity or political ideology, precisely because IH is flexible where religious and political views are fixed. People who are open to new information are more likely to change their beliefs when they are presented with evidence that contradicts their current views.

Religion and political views also related to vaccine attitudes, but the strength of these relationships varied by country. In multiple regression models, unique effects of political conservatism held in the United States and Canada but were non-significant in the UK sample. This could be due to the greater vocal political division on vaccine attitudes in the United States and Canada (see also Pennycook et al., 2020). In comparison, there has been less political opposition to vaccines in the United Kingdom, where a conservative government oversaw a largely successful covid-19 vaccination during the pandemic, with over 90% of eligible people receiving at least one vaccine dose (UK Health Security Agency, 2022). Religiosity was a strong predictor of anti-vaccine attitudes in the American sample, but religiosity did not predict vaccine attitudes in the multiple regression analyses of either Canadian or British samples. Surprisingly, belief in science was the weakest

predictor of vaccine attitudes across all countries, despite bearing the greatest relevance to vaccine attitudes. This implies the possibility that persuasion tactics aimed at beliefs themselves (i.e. promoting science and facts about vaccination) may not be as effective as methods aimed at changing the way people *think about* their beliefs (i.e. openness to changing their minds and discarding poor ideas). In further studies, IH may be studied to explain some relationships between vaccine attitudes and other kinds of beliefs, such as conspiratorial thinking, reactance, and strong individualistic worldviews (Hornsey et al., 2018).

We selected the United States, Canada, and the United Kingdom to compare country differences in religion and politics on vaccine attitudes, and to test cross-country robustness of IH and other beliefs as predictors. Our hypotheses were supported by results, but research should be extended to other populations, especially non-WEIRD cultures that differ in multiple ways from our samples, including differences in religion and political systems. We expect that IH should similarly predict vaccine judgments in other cultures, by shaping the capacity to evaluate credible new ideas and discard bad ideas. Other limitations could be addressed with further studies. Participants here were recruited through Amazon MTurk, which may limit the generalizability of results. Future studies might try to replicate these findings with other survey methods and larger samples to improve overall generalizability. In these studies, we used a scale of "liberal" to "conservative" to assess political attitudes, but these terms may have different connotations across countries. Political ideology is also often framed in terms of left versus right orientation, and studies may also investigate other kinds of political ideology outside of this polarized framing of political attitudes. Finally, future research could follow the relationship between IH and other science attitudes, and how it may relate to different aspects of scientific attitudes.

Conclusion

Vaccination has become a controversial issue where personal attitudes can be influenced by other pre-existing beliefs, such as religious and political views. But this research found it was differences in intellectual humility—a kind of belief about belief—that most consistently predicted vaccine attitudes across samples in the United States, Canada, and the United Kingdom. More research is needed, but we think these results are hopeful, as it suggests that promoting the values of IH as a potential avenue to improve vaccine attitudes by changing way people approach their own knowledge.

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Supplemental material

Supplemental material for this article is available online.

Notes

1. Cohen's (1988) f^2 is a measure of effect size which allows an evaluation of local effect size, that is, one variable's effect size within the context of a multivariate regression model (Selya et al., 2012).

2. Follow-up regression analyses compared the four intellectual humility (IH) facets as predictors of vaccine attitudes. See online materials: https://osf.io/cyduk/?view_only=5a5d3453f7df47ae90df6ce024e283b2.
3. In all studies, participants were also given options "third gender/ non-binary" or "other" for gender, but no respondents selected these options.
4. Some previous research suggests female gender predicts greater vaccine hesitancy (e.g. Morales et al., 2022). But no such effects were observed in any studies here, in either correlations or regression analyses.
5. Follow-up regression analyses compared four IH facets as predictors of vaccine attitudes. See online materials.
6. Follow-up regression analyses compared the four IH facets as predictors of vaccine attitudes. See online materials.

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