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Evaluating the relationship between moral values and vaccine hesitancy in Great Britain during the COVID-19 pandemic: A cross-sectional survey

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ABSTRACT

Rational/Objective: Mandating vaccinations can harm public trust, and informational interventions can backfire. An alternative approach could align pro-vaccination messages with the automatic moral values and intuitions that vaccine-hesitant people endorse. The current study evaluates the relationships between six automatic moral intuitions and vaccine hesitancy.

Methods: A cross-sectional survey was designed using Qualtrics (2020) software and conducted online from April 6th to April 13, 2021. A representative sample of 1201 people living in Great Britain took part, of which 954 (514 female) passed the attention check items. Participants responded to items about their automatic moral intuitions, vaccination behaviours or intentions related to COVID-19 vaccines, and general vaccine hesitancy. Regressions (with and without adjustments for age, gender, and ethnicity) were performed assessing the association between endorsement of each automatic intuition and self-reported uptake of COVID-19 vaccines, and between each automatic intuition and general vaccine hesitancy.

Results: People who endorsed the authority foundation and those who more strongly endorsed the liberty foundation tended to be more vaccine hesitant. This pattern generalises across people's self-reported uptake of COVID-19 vaccines and people's hesitancy towards vaccines in general. To a lesser extent people who expressed less need for care and a greater need for sanctity also displayed greater hesitancy towards vaccines in general. The results were consistent across the adjusted and non-adjusted analyses. Age and ethnicity significantly contributed to some models but gender did not.

Conclusion: Four automatic moral intuitions (authority, liberty, care, and sanctity) were significantly associated with vaccine hesitancy. Foundation-aligned messages could be developed to motivate those people who may otherwise refuse vaccines, e.g., messages that strongly promote liberty or that de-emphasize authority voices. This suggestion moves away from mandates and promotes the inclusion of a more diverse range of voices in pro-vaccination campaigns.

1. Introduction

1.1. Background

Overcoming many public health challenges will require not only system changes but also individual-level behaviour change. Some behaviour changes require people to disrupt or replace old habits, like

eating more vegetables or washing hands more frequently (Gardner and Rebar, 2019). For people willing to change, interventions that align with their intentions can help (Adams et al., 2014). But, to achieve behaviour change on a population-level, policymakers need also to engage people who are not already convinced to take up the proposed change. For example, public health initiatives engage those who drink excessive amounts of alcohol, consume tobacco, and decide not to take up

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vaccines.

'Vaccine hesitancy' refers to a delay in acceptance or refusal of vaccinations despite their availability (MacDonald, 2015). Hesitancy towards COVID-19 vaccines has decreased over time (Bacon and Taylor, 2021; Office for National Statistics, August, 2021). As of December 2021, 90% of residents over 12 years old in the United Kingdom had received at least one COVID-19 vaccination, and 59% had received a booster. Targeted communications helped reduce initial disparities in uptake across ethnic groups, but public trust remains a major concern (United Kingdom Government, 2021). Mandates can increase vaccinations, but mandates can also diminish the public trust necessary to sustain the uptake of future vaccines (Betsch and Böhm, 2016; Smith et al., 2021). Open science and evidence-informed policies help, but public health messaging could also target psychological antecedents of vaccine hesitancy in a way that people are ready to consider.

A psychological antecedents approach is one of many approaches within the vast landscape of vaccine hesitancy theories. Other disciplines such as sociology and history seek to explain vaccine hesitancy by focusing on wider contexts, including political and socio-cultural influences. We focus on individual-level attitudes, beliefs, and behaviours (Peretti-Watel et al., 2015). In 2015, The Strategic Advisory Group of Experts on Immunization (SAGE) highlighted three psychological antecedents of vaccine hesitancy in their 3C model, including confidence, complacency, and constraints (MacDonald, 2015). Since that time research has expanded, as have the number of antecedents. The 5C model includes two additional psychological antecedents (calculation and collective responsibility), and all five can be influenced by informational interventions (Betsch et al., 2015, 2018).

Informational interventions are often based on a knowledge-deficit approach, which assumes that hesitancy can be overcome by updating people's beliefs with more accurate information. However, systematic reviews find that knowledge poorly predicts vaccine hesitancy behaviour (Dubé et al., 2015; Jarrett et al., 2015), and informational interventions based on facts and figures may backfire (Pluviano et al., 2017). Rather than focusing on knowledge and beliefs, the current study evaluates how vaccine hesitancy behaviours might be shaped by situational influences and largely automatic and unconscious cognitive processes, consistent with a large body of research on judgement and decision-making (Thaler and Sunstein, 2021). The theory we focus on is about automatic moral intuitions.

Automatic moral intuitions arise often without awareness. For example, a person from a western country might automatically feel disgusted after learning that dogs are farmed for human consumption in Korea. After these judgements are formed, people seek confirmatory facts and figures, e.g., about how intelligent dogs are, while ignoring the intelligence demonstrated by animals farmed for human consumption in western countries. In other words, intuitions come first, and strategic reasoning comes second (Haidt and Joseph, 2008; 2011, 2012). This process resembles confirmation bias, a cognitive phenomenon that may partially drive people's persistent beliefs in conspiracy theories (Van Prooijen and Douglas, 2018). If automatic intuitions underlie people's attitudes about vaccines, then an alternative to the knowledge-deficit approach is needed. One approach might be called a 'foundation-aligned approach'.

Moral Foundations Theory describes six automatic intuitions, called foundations, that influence people's judgements (Graham et al., 2011). The foundations include care (concerns about others' wellbeing), fairness (concerns about proportionality), loyalty (about in/out-group relations), authority (about following rules/traditions), sanctity (about purity), and liberty (about freedoms) (Haidt, 2012). Many pro-vaccination messages focus on care and fairness, e.g., mentioning how many lives vaccines save and that vaccines protect others (Cucci-niello et al., 2022). If other foundations play a role, new foundation-aligned messages could prove beneficial. Moral Foundations Theory has been criticised for not accurately representing possible biological mechanisms, such as genes (as Curry et al., 's 2019

Morality-As-Cooperation-framework) or neural processes (as Shein and Gray's 2017 Theory of Dyadic Morality). However, it has described factors that influence people's decision-making around many controversial topics and across many cultures (Doğruyol et al., 2019).

Going with the grain of people's automatic cognitive and behavioural patterns can 'nudge' behaviour in desirable directions (Thaler and Sunstein, 2021). Foundation-aligned messages have already been used to alter people's willingness to take actions to mitigate climate change (Dickinson et al., 2016), to support political candidates (Voelkel and Feinberg, 2018), and to recycle (Kidwell et al., 2013). Studies already suggest that moral foundations play a role in people's attitudes about vaccines, all of which focus on the vaccination of children. In the United States, Amin et al. (2017) found that, compared to low-hesitancy parents, high-hesitancy parents more strongly endorsed the sanctity and liberty foundations and more weakly endorsed the authority foundation. In Australia, Rossen et al. (2019) found that, compared to vaccine acceptors, parents who rejected vaccines more strongly endorsed the care and sanctity foundations and more weakly endorsed the authority foundation. Lastly, Hornsey et al. (2018) investigated the psychological roots of people's hesitance towards the vaccination of children across 24 nations. They found a significant relationship between the sanctity foundation and hesitancy across 17 nations, including the United Kingdom, but did not assess the other foundations.

1.2. Study aims

The current study examines adult hesitancy towards vaccines in general in Great Britain. The main aim is to assess the association between the six moral foundations and vaccine hesitancy. In addition, we describe the actual and intended uptake of COVID-19 vaccines for people invited and those not yet invited to take up the vaccine.

2. Materials and methods

2.1. Design/setting

The cross-sectional survey was designed using Qualtrics (2020) and conducted online from April 6th to April 13th, 2021. On the 13th of April, the United Kingdom's Joint Committee on Vaccination and Immunisation announced that Phase 1 of its vaccination programme was complete (Department of Health and Social Care, 2021a, 2021b). During Phase 1, residents over 50 years old or experiencing a high-risk condition were offered their first vaccination (Department of Health and Social Care, 2020c). The study was designed according to the STROBE checklist (Vandenbroucke et al., 2007).

2.2. Patient and public involvement statement

Our aim for public involvement was to gain insights from members of the public regarding our project design and delivery according to the United Kingdom Standards for Involvement (National Institute for Health Research, 2021). Contributors were offered an honorarium for their time of £20.00 per hour. Contributors were recruited through The NIHR Applied Research Collaboration (ARC) West Midlands networks, which includes contributors from a range of communities, ethnicities, and genders. The initial research idea was discussed with five contributors before obtaining ethics. They provided input to the design of the questionnaire, ensuring questions followed a logical structure and were worded clearly. One contributor, who is also a co-author (SR), was involved in decision-making throughout and helped design a public engagement event. The public engagement event was conducted with 17 attendees (including 7 public contributors, 5 immunisers, and 5 public health specialists) who helped clarify interpretations of the presented findings.

2.3. Ethical approval

The study was approved by the University of Warwick's Biomedical Research Ethics Committee (ID: 110/19–20) and pre-registered on Open Science Framework (<https://osf.io/n5shb/>). Anonymous data and analysis files are available as Electronic Supplemental Materials A, B, C, and D. Survey participants provided their informed consent before advancing to the survey items. Participants who completed the survey were compensated with points, worth approximately £1.00, which they could spend in an online store.

2.4. Participants

A nationally representative sample of participants from England, Wales, and Scotland was recruited over Bilendi's survey market panel (Bilendi, 2021) to take part in a study titled: "Intuitions and attitudes towards COVID-19 vaccines in Great Britain". A quota-based sampling method was used to match population estimations for age, region, sex (a proxy for gender), and socioeconomic status (provided by the National Readership Survey in 2016). Due to the quickly evolving COVID-19 pandemic, we could not anticipate when vaccines would be available, which could affect the types of questions we could ask and the numbers of participants in our analyses. Thus, the present study seeks to extend previous findings rather than directly replicate them. Our planned recruitment of 1200 participants was informed by Green's (1991) 'rule of thumb' for partial correlations, Amin et al.'s (2017) study, and anticipated attrition. Amin et al.'s study (2017) included 1007 participants to capture small effects. A 20% attrition rate was anticipated for participants failing to respond appropriately to attention check items, which is the attrition rate found in a 2019 study using the Moral Foundations Questionnaire in the United Kingdom (Harper and Hogue, 2019).

2.5. Measurements

The survey included items related to the moral foundations, COVID-19 vaccination behaviours/intentions, general vaccine hesitancy, and demographics. Half the participants were randomly allocated to respond to items about the moral foundations first, and half to items about their vaccination behaviour/intentions first. Then, all participants completed items about their general vaccine hesitancy. To prevent item-missing data, the online survey set-up required responses for all items.

Moral Foundations. The Moral Foundations Questionnaire captures participant endorsements of the care, fairness, loyalty, authority, and sanctity foundations. The Liberty Foundations Questionnaire captures the liberty foundation (Iyer et al., 2012). Together, these questionnaires include 39 items composed of two subsets. The first subset asks participants about the relevance of each statement to their moral judgements, e.g., a care item reads: "Whether or not someone suffered emotionally". The second subset asks how much they agree with each statement, e.g., a care item reads: "Compassion for those who are suffering is the most crucial virtue". Participants responded to items using a six-point scale, where one indicates "not at all relevant" (for the first subset) or "strongly disagree" (for the second subset), and six indicates "extremely relevant" (for the first subset) or "strongly agree" (for the second subset). The care, fairness, loyalty, authority, and sanctity foundations are captured with 6 items (scores range from 6 to 36), and liberty is captured with 9 items, of which one is reverse worded and scored (scores range from 9 to 54). Higher scores indicate stronger endorsements.

The Moral Foundations Questionnaire also contains two attention check items. For example, the questionnaire instructions recommend removing participants who indicate any level of disagreement with this item from further analyses: "It is better to do good than to do bad".

COVID-19 Vaccination Behaviour/Intentions. The items capturing vaccination behaviours and intentions were newly created and relate to behavioural theories of vaccine hesitancy. The first asked, "Have you

been invited to receive a COVID-19 vaccination?" Those who indicated being invited were then asked whether they received their vaccination (yes/no). Those who reported not receiving their vaccination were asked to describe why in a free-text box. Participants who indicated not being invited were asked about their intentions using a 3-item scale, informed by a previous scale about intentions to take up vaccines in general (Britt and Englebert, 2018). The items read: "I intend to get a COVID-19 vaccination when it is available", "I plan to get a COVID-19 vaccination when it is available", and "I want to get a COVID-19 vaccination when it is available". Participants responded to each item using a 6-point scale, where 1 indicates "strongly disagree" and 6 "strongly agree" (scores range from 6 to 18). Higher scores indicate greater intentions.

General Vaccine Hesitancy. General vaccine hesitancy was assessed using a 9-item Vaccine Hesitancy Scale (Luyten et al., 2019), which is an abbreviated version of the original 10-item scale (Larson et al., 2015). This scale relates to attitudinal theories of vaccine hesitancy. It includes items related to confidence (e.g., "Being vaccinated is important for the health of others in my community") and risk (e.g., "I am concerned about serious adverse effects of vaccines"). Participants responded to each item using a 5-point scale, where 1 indicates "strongly disagree" and 5 "strongly agree"; two items are reverse worded and scored (scores range from 9 to 45). Higher scores indicate lower hesitancy towards vaccines generally.

Demographics. Information was collected about participants' age, gender, region, socio-economic status, ethnicity, educational attainment, whether they were experiencing a high-risk clinical condition, and whether they were employed as frontline health or social care workers. Demographic items are provided in Electronic Supplemental Material E.

2.6. Analyses

Statistical Analyses. Analyses were conducted using R version 3.6.2. Participants who failed an attention check item were removed from the analyses. Descriptive analyses (tallies, percentages, etc.) for the main variables were examined across participant characteristics. Cronbach's alpha was calculated for the COVID-19 intentions scale. Spearman's rho correlation coefficient was calculated between the COVID-19 intentions scale and the Vaccine Hesitancy Scale, along with the 95% confidence intervals (CI) using the Fieller et al. (1957) method.

Three sets of regression analyses were conducted. The first set was conducted on the full sample to detect the relationship between the six moral foundations and categorical levels of vaccine hesitancy. Informed by Amin et al.'s study (2017), the Vaccine Hesitancy Scale scores were categorised into three hesitancy groups: Low (scores from 32 to 45), Medium (scores from 23 to 31), and High (scores from 9 to 22). One regression compared Medium versus Low hesitancy groups, and another compared High versus Low hesitancy groups. *Post-hoc* analyses are also performed with hesitancy as a continuous outcome measure.

The following two sets of analyses were then split into participants who had been invited and those who had not yet been invited. For participants already invited, a logistic regression examined the relationship between each foundation and vaccination behaviour (yes and no). Results of the logistic regression models were measured using crude and adjusted odds ratios (ORs) and presented with their 95% CIs. In addition, we also assessed whether participants who reported taking the vaccine expressed different hesitancy than those who did not, using a two-sample independent samples *t*-test with Cohen's *d* to estimate the effect sizes.

For participants not yet invited, a linear regression examined the relationship between each foundation's scores and the Vaccine Hesitancy Scale scores. As the COVID-19 intentions scale and the Vaccine Hesitancy Scale correlated above the pre-determined threshold of 0.70, the Vaccine Hesitancy Scale score was used. Results of the regression models were measured using crude and adjusted coefficients and presented with their 95% CIs. While we had planned to conduct an ordinal regression analysis, the large number of combinations made these too

complicated to practically report.

For all regressions, significant relationships were assessed using a 0.05 alpha level and results were reported for non-adjusted and adjusted analyses. Adjustments were made for demographic variables potentially associated with COVID-19 vaccine uptake, including gender (Evagora-Campbell et al., 2021) and ethnicity (Razai et al., 2021) as categorical variables, and age (Sethi et al., 2021) as a continuous variable. Categories with few participants were removed from the analyses. For gender, the 3 participants identifying as non-binary or other were removed. For age, the single participant who preferred not to say was removed. For ethnicity, the 15 participants identifying as other or who preferred not to say were removed, and the remaining participants who identified as Mixed ($n = 17$), Asian ($n = 70$), and Black ($n = 15$) were merged into 'BME'. *Post-hoc* analyses were also performed wherein different ethnicities are explored.

Qualitative Analyses. The free-text explanations provided by participants who had not taken up their invitation to be vaccinated were independently coded by two researchers (KS and LK). The codes included the five psychological antecedents to vaccination identified by Betsch et al. (2018). These measures relate to attitudinal theories of vaccine hesitancy. The five antecedents are "confidence" (trust in the effectiveness and safety of vaccines, the system that delivers them, and the motivations of policy-makers), "complacency" (perceived risks of vaccine-preventable diseases and need for vaccination as a preventive action), "constraints" (issues with the availability, affordability, and accessibility of immunization services), "calculation" (excessive information seeking and weighing of costs and benefits), and "collective responsibility" (willingness to protect others). An "other" code was included to account for responses that did not fit the 5C model. Initial reliability was described using Cohen's Kappa. The percentage of responses coded as each antecedent were calculated.

3. Results

3.1. Participant characteristics

The survey was completed by 1201 participants, of which 954 (514 female) passed all attention check items (79%) and were retained in further analyses. Attrition was similar across stratified characteristics (age, gender, region, and socio-economic status, see Appendix). The mean age of participants was 49 years ($SD = 17$), one participant did not prefer to say their age. The majority, 88% ($n = 837$), identified as White, and about half ($n = 485$, 51%) had completed a college or university course. Almost one-fifth ($n = 175$, 18%) reported experiencing a high-risk health condition, and 10% ($n = 97$) identified as a frontline worker. Further characteristics are provided in Table 1. For participants invited, we also provide the percentage who self-report receiving their COVID-19 vaccination. For participants not yet invited, mean intentions to take up a COVID-19 vaccine are provided. Further descriptive statistics (means and standard deviations) related to endorsements of each moral foundation and the vaccine hesitancy scale are provided in the Appendix.

3.2. COVID-19 scale and vaccine hesitancy scale

The internal reliability of the COVID-19 intentions scale was high (0.98). The COVID-19 intentions scale scores and the Vaccine Hesitancy Scale scores were strongly correlated ($\rho(300) = 0.72$, $p < 0.001$; 95% CI: 0.66, 0.77).

3.3. All participants

All 954 participants completed the Vaccine Hesitancy Scale, with scores ranging from 9 to 45. Their mean score indicates high acceptance

Table 1
Characteristics of participants by invited and not invited groups.

		Total	Invited		Not invited	
		N	n	Behaviour -vaccinated- n (%)	n	Intentions Mean score out of 18 (SD)
All		954	654	588 (90%)	300	14.5 (4.9)
Age	18–54	565	270	227 (84%)	295	14.5 (4.9)
	55+	388	384	361 (94%)	4	12.8 (7.1)
Gender	Prefer not to say	1	0	0	1	16.0 (n/a)
	Male	437	303	273 (90%)	134	15.2 (4.6)
	Female	514	349	313 (90%)	165	14.0 (5.1)
	Non-binary/other	3	2	2 (100%)	1	15.0 (n/a)
Region	North East	33	24	23 (96%)	9	16.9 (2.1)
	North West	108	73	65 (89%)	35	13.9 (5.4)
	Yorkshire and The Humber	84	57	54 (95%)	27	13.4 (4.8)
	East Midlands	72	47	44 (94%)	25	15.6 (4.0)
	West Midlands	79	50	42 (84%)	29	14.1 (5.4)
	East of England	75	55	52 (95%)	20	14.5 (4.8)
	London	115	69	57 (83%)	46	13.8 (5.5)
	South East	155	119	111 (93%)	36	14.8 (4.8)
	South West	97	67	58 (87%)	30	15.6 (4.1)
	Wales	49	34	29 (85%)	15	15.1 (5.3)
	Scotland	87	59	53 (90%)	28	14.4 (5.1)
	Higher	502	325	300 (92%)	177	14.5 (5.0)
	Lower	452	329	288 (88%)	123	14.5 (4.8)
Education level	Below college or university	469	332	300 (90%)	137	14.1 (5.2)
	At least college or university	485	322	288 (89%)	163	14.9 (4.6)
Ethnicity	White	837	603	553 (92%)	234	14.7 (4.9)
	Mixed	17	11	7 (64%)	6	12.3 (6.2)
	Asian	70	28	21 (75%)	42	14.5 (4.4)
	Black	15	7	4 (57%)	8	9.8 (5.8)
	Other	5	4	2 (50%)	1	3.0 (n/a)
	Prefer not to say	10	1	1 (100%)	9	15.6 (2.4)
	Yes	175	157	141 (90%)	18	14.6 (5.6)
High-risk	No	756	483	437 (91%)	273	14.5 (4.8)
	Prefer not to say	23	14	10 (71%)	9	12.7 (6.3)
	Yes	97	81	73 (90%)	16	13.3 (5.7)
Frontline	No	857	573	515 (90%)	284	14.6 (4.9)

of vaccines in general (Mean = 36.2, SD = 6.9). Of these participants, 756 (79%) were placed in the Low Hesitancy group, 149 (16%) in Medium, and 49 (5%) in High. The *post hoc* power of our study to detect the estimated effects was calculated using a simulation, which suggested that our study had 70% power to detect the obtained observed effects of the authority and the sanctity foundations, 90% power to detect the obtained observed effect of the care foundation, and >99% power to detect the observed effect of the liberty foundation.

We assessed medium versus low hesitancy and high versus low hesitancy as binary variables. For the medium versus low hesitancy analysis, the moral foundations of care (OR = 0.92, 95% CI: 0.87, 0.98) and authority (OR = 0.90, 95% CI: 0.85, 0.95) were negatively associated with hesitancy (p 's < 0.05), and liberty (OR = 1.07, 95% CI: 1.03, 1.11) was positively associated with hesitancy (p 's < 0.05). Age and ethnicity also significantly contributed to the model in the adjusted analysis, again with participants identifying as younger and as BME being more likely to express medium than low hesitancy (p 's < 0.01). For the high versus low hesitancy analyses, care (OR = 0.86, 95% CI: 0.78, 0.95) and authority (OR = 0.87, 95% CI: 0.80, 0.95) were negatively associated with hesitancy group, and sanctity (OR = 1.11, 95% CI: 1.03, 1.21) and liberty (OR = 1.22, 95% CI: 1.15, 1.30) were positively associated (p 's ≤ 0.01). These findings are displayed in Fig. 1. Tabular findings are provided in the Appendix.

The *post-hoc* analyses appear in Electronic Supplemental Materials F, which use a continuous outcome measure for hesitancy and with ethnicities further distinguished for the categorical analysis. The same foundations appeared as having a significant relationship across the logistic (high vs low) and continuous analyses. The Black ethnicity group was identified as a significant predictor in the Medium vs Low analysis (more likely to be Medium).

3.4. Participants not yet invited to receive a COVID-19 vaccination

Three hundred participants (31%) had not yet been invited to receive a COVID-19 vaccination. Their mean COVID-19 intention scores (Mean = 14.5, SD = 4.9) and Vaccine Hesitancy Scale scores were high (Mean = 34.5, SD = 7.5); recall that a high hesitancy scale score indicates lower hesitancy towards vaccines in general. In both non-adjusted and adjusted analyses, the following foundations significantly predicted Vaccine Hesitancy Scale scores: care, authority, sanctity, and liberty

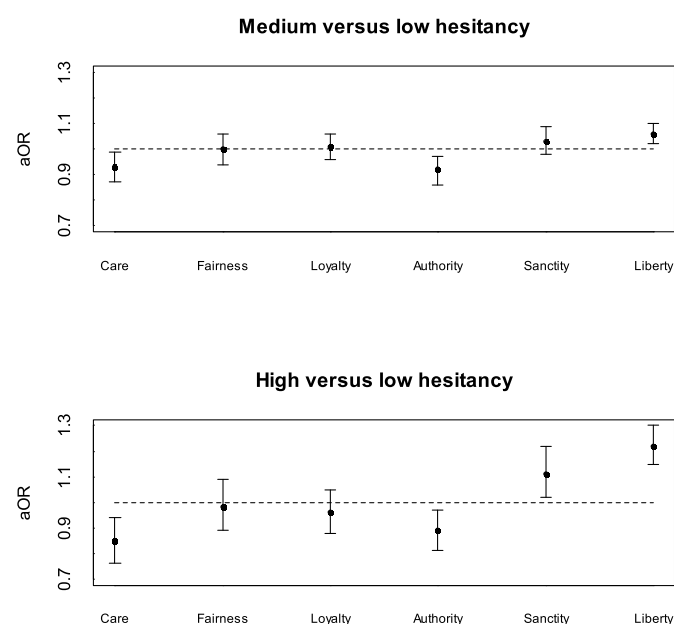


Fig. 1. Adjusted odds ratios (aORs) assessing the association of each foundation with vaccine hesitancy.

(p 's < 0.05), see Table 2. Participants who more strongly endorsed the care ($B = 0.29$, CI: 0.04, 0.54) and authority ($Beta = 0.51$, CI: 0.28, 0.75) foundations were less hesitant towards vaccines in general. In contrast, participants who more strongly endorsed the sanctity ($B = -0.36$, CI: 0.57, -0.015) and liberty ($B = -0.40$, CI: 0.53, -0.26) foundations were more hesitant. Age and ethnicity were not associated with vaccine hesitancy ($p > 0.05$). The *post-hoc* analysis in Electronic Supplemental Material F identified no ethnicities as significant predictors.

3.5. Participants already invited to receive a COVID-19 vaccination

Six hundred and fifty-four participants (69%) had received an invitation to be vaccinated, of which 588 (90%) reported receiving a vaccination. Invited participants who took up the vaccine reported less hesitancy ($M = 38.19$, $SD = 4.97$) than those who had not ($M = 25.73$, $SD = 7.73$; $t(652) = 18.05$, $p < 0.001$, $d = 2.35$).

The results of the logistic regression are presented in Table 3. In both non-adjusted and adjusted analyses, the following two foundations were significantly associated with self-reported vaccination behaviour: authority and liberty ($p < 0.05$). A small increase of one score point out of 30 for the authority scale increased the odds of vaccination by 15% (OR = 0.85, 95% CI: 0.78, 0.92), and an increase in one score point in liberty decreased the odds by 12% (OR = 1.12, 95% CI: 1.07, 1.19). In the adjusted model, younger participants were more likely to report being unvaccinated (OR = 0.98, 95% CI: 0.96, 0.99, $p < 0.01$), and BME participants were also more likely to report being unvaccinated (OR = 2.77, 95% CI: 1.24, 6.04, $p < 0.01$). The *post-hoc* analysis in Electronic Supplementary Material B revealed that participants identifying as Black and Mixed ethnicities were less likely than those identifying as White to self-report receiving the vaccine; although, uncertainty was high, as the sample sizes for Black and Mixed ethnicities were low.

3.6. Qualitative Analyses

Of the 654 participants invited to be vaccinated, 66 reported not receiving a vaccination, all of whom (100%) provided a free-text response explaining why. There was substantial agreement between reviewer codes, $k(66) = 0.71$, 95% CI: 0.58 to 0.84, $p < 0.001$. The most frequently identified psychological antecedent was confidence ($n = 29$), followed by constraints ($n = 6$), calculation ($n = 4$), and complacency ($n = 1$). No responses were coded as collective responsibility. The remaining 26 were coded as "other", of which 12 indicated that participants had booked their vaccination for a future date, 4 reiterated

Table 2

Regressions examining the relationship between the moral foundations and vaccine hesitancy for participants not yet invited.

	Non-Adjusted (n = 300)		Adjusted (n = 288)	
	Coefficients	P-value	Coefficients	P-value
Moral Foundations				
Care	0.29 (0.04,0.54)	0.03*	0.36 (0.11,0.62)	0.01*
Fairness	0.20 (-0.05,0.44)	0.12	0.13 (-0.12,0.38)	0.32
Loyalty	-0.22 (-0.45,0.01)	0.06	-0.19 (-0.42,0.04)	0.11
Authority	0.51 (0.28, 0.75)	<0.001*	0.46 (0.21,0.72)	<0.001*
Sanctity	-0.36 (-0.57, -0.15)	0.001*	-0.29 (-0.52, -0.07)	0.01*
Liberty	-0.40 (-0.53, -0.26)	<0.001*	-0.39 (-0.53, -0.25)	<0.001*
Age (continuous)			-0.08 (-0.16,0.01)	0.07
Gender (reference Male)				
Female			-1.61 (-3.31,0.09)	0.06
Ethnicity (reference White)				
BME			-0.60 (-2.80,1.60)	0.59

* $p < 0.05$.

Table 3

Regressions examining the relationship between the moral foundations and self-reported COVID-19 vaccination behaviour among participants already invited.

	Non-Adjusted (n = 654)		Adjusted (n = 647)	
	Odds Ratio (95% CI)	P-value	Odds Ratio (95% CI)	P-value
Moral Foundations				
Care	0.95 (0.87,1.03)	0.23	0.98 (0.89,1.07)	0.63
Fairness	1.06 (0.97,1.15)	0.23	1.04 (0.95,1.14)	0.41
Loyalty	0.99 (0.92, 1.07)	0.75	0.98 (0.91,1.06)	0.60
Authority	0.85 (0.78,0.92)	<0.001*	0.87 (0.80,0.95)	0.002*
Sanctity	1.06 (0.99,1.13)	0.12	1.04 (0.97,1.12)	0.29
Liberty	1.12 (1.07,1.19)	<0.001*	1.12 (1.06,1.18)	<0.001*
Age (continuous)			0.98 (0.96,0.99)	0.01*
Gender (reference Male)				
Female			0.84 (0.47,1.50)	0.56
Ethnicity (reference White)				
BME			2.77 (1.24,6.04)	0.01*

*p < 0.05.

a preference against getting the vaccine, and 3 expressed uncertainty (e.g., “Not sure”). The remaining “other” responses may suggest potential gaps in the psychological antecedents model, e.g., 2 responses involved needle phobias and 5 expressed medical barriers (e.g., allergies). Examples of free-text responses are provided in Table 4.

4. Discussion

4.1. Main results

The current study is the first evaluation describing the relationships between moral foundations and COVID-19 vaccination behaviour. Additionally, the relationships between those intuitions and hesitancy towards vaccines in general were examined. The study took place midway through the vaccination rollout in the United Kingdom, allowing a unique examination of people invited and those not yet invited. People who had been invited but failed to act were more likely to strongly endorse the liberty foundation and weakly endorse the authority foundation. General vaccine hesitancy showed the same trend across invited and uninvited groups. In addition, weakly endorsing the care foundation and strongly endorsing the sanctity foundation were associated with greater hesitancy across groups.

The moral foundations identified as being associated with vaccine hesitancy largely align with those found in previous studies (Amin et al., 2017; Hornsey et al., 2018; Rossen et al., 2019). This is important given the role of vaccination uptake during the COVID-19 pandemic and the

Table 4

Examples of responses by codes.

Code	Free-text examples
Confidence	“I don’t trust the vaccine” “I don’t trust the entire situation”
Constraints	“No appointments available and no vaccines at my local surgery”
Calculation	“I have not found a convenient time to get it yet” “I have done diligent research into the science of the vaccine and the weighed up the risks versus the potential benefits and have made an informed decision not to have it.”
Complacency	“The vaccine is not a sure sign you won’t catch it or pass it on. I also am sure I had covid in 2020.”
Collective Responsibility	No responses were coded as collective responsibility
None	“I am still waiting for my [time] slot.” “Do not want it” “Not sure” “I have a strong needle phobia.” “I am allergic to several things and have had an anaphylaxis shock in the past”

difference in approach between this study and prior research, including having surveyed adults about their own vaccination behaviours rather than child vaccinations. One difference arose for the care foundation. In the current study, participants who more strongly endorsed the care foundation were less hesitant towards vaccines in general. In contrast, Rossen et al. found that parents who more strongly endorsed the care foundation were more likely to reject vaccines. The interplay between considerations about oneself versus others may play a role. Previous research suggests that people tend to make more risky decisions for themselves than others, and this effect generalises to parents’ decisions about themselves compared to parents’ decisions about their children (Batteux et al., 2020).

4.2. Strengths and limitations

A strength of the current study is the large nationally representative sample of participants. A limitation is that our participants may not be representative of unobservable characteristics, e.g., they may be more confident using the internet than the general public. However, confidence using the internet is unlikely to bias responses in a particular direction, as people can use the internet both to find information in support of and against vaccinations (Sak et al., 2015). It is also uncertain how large an effect needs to be to inform a message that could ultimately change behaviour. In our study, for participants already invited, a small increase of just one point for the authority scale increased the odds of vaccination by 15%, and a one-point increase for liberty decreased the odds of vaccination by 12%. As the costs of changing how public health messages are worded are low, even small effects may cost-effectively shift the population distribution to improve public health.

Our three-item COVID-19 hesitancy scale provides a new measure of hesitancy. However, the scale’s predictive validity has not yet been assessed beyond its relationship with the Vaccine Hesitancy Scale. Additionally, the high internal reliability suggests there is high item redundancy. The same limitation extends to the seven-item Oxford COVID-19 hesitancy scale (Freeman et al., 2020). Where a briefer scale is preferred, one item may be preferred over three items (Hulin et al., 2001).

Another strength of the study was its attempt to capture self-reported reasons for not being vaccinated according to five psychological antecedents (Betsch et al., 2018). However, responses were brief, and many were coded as “other”. The responses about medically supported barriers (e.g., a previous anaphylaxis reaction) and needle phobias are difficult to classify within the five antecedent model. They are not clearly about ‘confidence’ in vaccine safety, ‘calculation’ of risks and benefits, or ‘collective responsibilities’ for others, and do not necessarily entail that people do not feel at risk of vaccine-preventable diseases, i.e., ‘complacency’. Further, although previous anaphylaxis reactions could be construed as *inner* biological constraints and phobias as *inner* psychological constraints, they are not *externally* blocking the availability, affordability, or accessibility of vaccination services, which is core to the definition of ‘constraints’. The model could be extended to include biological and psychological factors that describe inner constraints to vaccinations.

A limitation of our study is that it only included participants from Great Britain. As in previous studies conducted in the region, we identified age (Sethi et al., 2021) and ethnicity (Razai et al., 2021) as being significantly associated with hesitancy, but not gender (Evagora-Campbell et al., 2021). Further research is likely required to understand the relationships between the moral foundations and vaccine hesitancy and different patterns may be found across cultures.

4.3. Directions for theory and practice

These findings make important incremental and practical contributions to Moral Foundations Theory and vaccine hesitancy theory (Corley and Gioia, 2011). Incrementally, this study extends Moral Foundations

Theory to adult vaccination and suggests some differences between how the foundations influence vaccination across adults and children. Regarding vaccine hesitancy theory, this work pushes psychological theories outward, considering factors beyond immediate psychological antecedents to the more distal moral foundations that may mediate or moderate hesitancy. This extension aligns with other recent research reporting that people's past experience and perceived social norms influence their vaccination intentions (Cucciniello et al., 2022). As direct persuasive messages may backfire (Pluviano et al., 2017), focusing on more indirect factors affecting vaccination may prove more effective. Additional research could further examine such structural links.

Haidt's (2012) Moral Foundations Theory is a descriptive account of how moral judgements are influenced by two processes that map onto the automatic and reflective processes described by dual-process theories of cognition (Evans and Stanovich, 2013). For Haidt, the reflective process simply serves the automatic intuitions. In contrast, Greene (2017) and Railton (2014) note that experience can influence moral reasoning, and this viewpoint underpins the current research. Changing judgements, and the behaviours that follow will require persuasive messages that do not elicit automatic intuitions against the desired behaviour. While Moral Foundations Theory is unlikely to explain all moral judgements, where it describes differences between groups it provides a rough architecture of factors that could be sensitive to persuasive nudges (Thaler and Sunstein, 2021).

New foundation-aligned messages could be developed targeting people who may otherwise refuse vaccines. This suggestion is a move away from mandates, which may diminish public trust (Smith et al., 2021), and a move away from the messages developed at the World Health Organization's 2021 Immunization Week, which appear to target people who strongly endorse the care and fairness foundations, e.g., "Vaccines bring us closer to a world where no one suffers or dies from a vaccine-preventable disease". Our findings suggest that these messages may not be latching onto the automatic intuitions of people hesitant to take up vaccines for themselves and may not further increase uptake.

Our suggestion to develop foundation-aligned messages is also advocated by Amin et al. (2017). Amin et al. (2017) proposed messages aligned with the liberty and sanctity foundations. For liberty, they suggest: "Take personal control of your child's health! Vaccinations can help your child and others be free to live a happy and healthy life" (p. 877). For sanctity they suggest: "Boost your child's natural defences against disease! Keep your child pure of infections – Vaccinate!" (p. 877). One may also attempt to create messages targeting people who weakly endorse the care foundations, by emphasising how quick and easy it is, e.g., "as easy as buying yourself a soft drink". Although this presupposes that there is a simple and reliable system available e.g., "Vaxi Taxis" offering a one-stop shop for people to receive their first COVID-19 vaccinations without pre-booked appointments (NHS England, 2021). Messages promoting uptake among people who weakly endorse the authority foundation may include messengers from the community, such as young adults.

As vaccine-hesitant people are only a small proportion of the population, new messages should complement messages already motivating people to take up the vaccines. The key point here is to create a broader range of inclusive and positive messages that are likely to bring those who would otherwise refuse vaccinations into the conversation. While messages are only one avenue through which to influence vaccination uptake, they are core components of public health campaigns, and we should use scientific approaches to modify their content in ways that enhance the chances of success.

5. Conclusion

The current study evaluates the relationships between six automatic intuitions posited by Moral Foundations Theory and general vaccine hesitancy. People who more strongly endorsed the liberty (and to a lesser extent the sanctity foundation), and those who more weakly

endorsed the authority (and to a lesser extent the care foundation), tended to display more vaccine-hesitant attitudes. The discussion proposes that novel, foundation-aligned pro-vaccination messages could be created to encourage people who are still hesitant to consider being vaccinated. More broadly, the moral foundations underlying resistance to other behaviour changes could be considered to improve public health.

Author contributions

The research idea was conceived by KAS and revised in collaboration with all co-authors. The investigation was conducted by SR, KAS, LK, and MS with supervision from AC. The statistical analyses were performed by AF and NS. Qualitative coding was conducted by KAS and LK. All co-authors contributed to the preparation, creation, and presentation of this work. KAS wrote the original draft which was then revised in collaboration with all co-authors.

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Data availability

The data have been made available as supplementary files.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2022.115218>.

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