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Will you get vaccinated? Trade-offs between purity, liberty and care predict attitudes towards Covid-19 vaccination

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Abstract

How do tensions between moral values predict how likely we are to receive Covid-19 vaccination? Previous work suggests that moral foundations, particularly purity and liberty, relate to decisions to vaccinate. In addition, research on the moral trade-off hypothesis suggests value in exploring trade-offs between foundations. We conducted three studies across the pandemic: at the start of the vaccine rollout (Study 1, N = 170); during delivery (Study 2, N = 328) and 2 years later (Study 3, N = 388). We find that trade-offs between purity and care and between liberty and care are predictive of higher levels of vaccine reluctance—individuals who endorse purity or liberty more, relative to care, were more reluctant towards Covid-19 vaccination, less likely to have received a vaccine and have lower intention to get future Covid-19 vaccines. This research highlights the relevance of moral values, and trade-offs between them, in vaccine attitudes and decisions.

KEYWORDS
Covid-19, moral foundations theory, moral judgement, moral trade-offs, vaccination

1 | INTRODUCTION

As 2019 entered its closing months, the world was stunned by the arrival of a fast-spreading novel respiratory virus powerful enough to bring the city of Wuhan to a grinding halt. Over the following years, we became familiar with what it is like to live through a global pandemic. In the United Kingdom, as in many countries, residents observed multiple periods of rocketing infection rates, daily death tolls and a series of lockdowns, alongside a race to create safe and effective vaccines (Institute for Government Analysis, 2021). The Covid-19 vaccine played a key role in strategies to manage the pandemic, particularly as new variants emerged and programmes for booster doses were rolled out. As the urgency of Covid-19 vaccination programmes begins to fade into memory, understanding the psychological factors that contribute towards vaccine uptake, or lack of, should remain a priority for ongoing strategies for managing Covid-19 as well as for vaccination programmes more widely.

Public campaigns have emphasised moral and civil duties to receive Covid-19 vaccination to protect others and reduce the spread, emphasising concerns for care and preventing harm. On the other hand, growing anti-vaccine rhetoric (Burki, 2020) emphasised 'unnatural' or unsafe contaminants in the vaccine itself (a concern for bodily purity) or concerns that vaccination programmes constitute corrupt agendas to erode personal freedom (a concern for liberty). Previous research has highlighted the role of moral values in influencing decisions to vaccinate with somewhat inconsistent effects (Amin et al., 2017; Heine & Wolters, 2021). The current context therefore presents a unique opportunity to explore how moral values relate to vaccination decisions as new vaccines are being developed and amid mass public health programmes to receive them.

Research considering Covid-19 vaccine attitudes began to emerge before the approval of the first Covid-19 vaccine in December 2020 (Mehzer, 2020), with a UK survey (Freeman et al., 2020) finding 16.6% of respondents unsure about receiving vaccination and 11.7% highly hesitant. Factors in this research relating to hesitancy included collective importance beliefs, vaccine efficiency beliefs, concerns about side-effects, vaccine development speed, excessive mistrust and prior healthcare experiences (Freeman et al., 2020). Other research has identified complacency, trust and confidence, convenience, sources of information and socio-demographic variations as key factors (Mills et al., 2020). Similarly, a study conducted after the approval of the first Covid-19 vaccines identified lack of trust as the biggest barrier to uptake, alongside concerns of unknown side effects (Razai et al., 2021). In addition, efforts to code online anti-vaccine narratives found frequently occurring themes to include framing of corrupt elites forcing lockdowns and vaccination for personal gain, concerns about physical or mental vaccine injury from bodily contaminants and attacks on personal and health freedoms (Hughes et al., 2021).

UK vaccination uptake statistics show that the majority of adults have chosen to receive a Covid-19 vaccine, and that much of this uptake occurred early in the rollout. As of March 2022, 85.9% of the population had received a complete initial protocol (two doses at the time) and a further 5.9% were partly vaccinated (UK Government, 2022). Booster rollouts began in autumn 2021 (NHS England, 2021), and as of March 2022, 67.4% of the population opted to receive the first booster dose (UK Government, 2022). By the end of August 2022, over 70% of people aged 12 years and older had received three or more doses (Office for National Statistics, 2023). Booster uptake is a crucial tool in managing outbreaks and new variants, as vaccine effectiveness has been shown to decline after 6 months (Wright et al., 2022). A minority of the population however remain reluctant to receive any Covid-19 vaccines and have declined invitations to receive primary doses and are unlikely to take up future doses. Even relatively low levels of vaccine reluctance could prove costly at both individual and societal levels.

1.1 | Vaccine attitudes and moral foundations

Prior to the emergence of Covid-19, vaccine hesitancy presented a consistent threat to public health and vaccine attitudes over time have been resistant to change. The World Health Organisation defines vaccine hesitancy as a delay in acceptance and/or refusal of treatment through vaccination, despite having access to available vaccination services (MacDonald et al., 2015), and identified it as one of the largest threats to global health following yearly declines of MMR vaccine uptake rates (Akbar, 2019). Given the role unvaccinated children have played in the increase in measles cases (Sanyaolu et al., 2019), most pre-pandemic research focused on parental reluctance toward childhood vaccination (e.g. Napolitano et al., 2018; Williams, 2014; Kestenbaum & Feemster, 2015). However, this research may not fully generalise to adults deciding to vaccinate themselves. Anti-vaccine websites commonly use 'cherry-picked' scientific evidence to attract, persuade and inflame the reader, alongside language targeting specific values such as freedom of choice and individualism (Moran et al., 2016). Anti-vaccine rhetoric may be especially persuasive to individuals who more highly endorse particular moral values, and thus find certain arguments more compelling. Understanding an individual's moral priorities can therefore provide important insight into their vaccine attitudes and decisions.

Developed to understand the similarities and variations in morality across cultures and contexts, Moral Foundations Theory (MFT: Haidt & Joseph, 2004; Graham et al., 2013; Iyer et al., 2012) proposes to explain individual differences in moral judgements based on the endorsement of six foundations: care (compassion, protecting others, preventing harm), fairness (valuing fair treatment, rights and justice), loyalty (concern for and value placed on the in-group), authority (obeying hierarchy and valuing tradition), purity (sensitivity to disgust and valuing bodily and spiritual purity) and liberty (valuing freedoms, resenting those who compromise freedoms; Haidt & Joseph, 2004; Iyer et al., 2012). Since its initial proposal, MFT has been applied to differentially predict political orientation (Graham et al., 2009) amongst other social and political attitudes and behaviours (e.g. Barnett & Hilz, 2017; Milesi et al., 2019; Dickinson et al., 2016).

In a 2017 study, Amin et al. (2017) applied MFT to parental vaccine hesitancy, and highlighted initially plausible connections between purity (concerns about bodily contamination from 'unnatural' substances), liberty (mandatory vaccination programmes violating civil liberties), authority (trust of scientists, and government and health authorities), care (preventing harm from disease, protecting vulnerable children) and fairness (concerns about unfair voice of pharmaceutical companies in determining health policy). They found that care and fairness were not predictive of vaccine hesitancy, and that parents with low-hesitancy tended to endorse authority. Medium-hesitancy participants were twice as likely as low-hesitancy participants to emphasise purity, and high-hesitancy participants were twice as likely to emphasise both purity and liberty. However, as noted by the authors, that there was no evidence for an effect of care is somewhat alarming, given that public campaigns and interventions tend to focus predominantly on care concerns, emphasising the role of vaccines in protecting others from harm (Amin et al., 2017). Other work has found variable effects across foundations. A survey of Black Americans found that care and loyalty predicted lower vaccine hesitancy and more favourable attitudes towards the Covid-19 vaccine, while purity and liberty predicted greater hesitancy (Nan et al., 2022). A study looking at the efficacy of emphasising foundations in government communications, found similar null effects for care as Amin et al. (2017), with the use of authority and liberty, and to a lesser extent purity, associated with vaccine uptake (Heine & Wolters, 2021). Other research has also linked disgust (an affective purity response) and vaccine reluctance (Luz et al, 2019). Overall, this literature indicates that moral values can be predictive of decisions to vaccinate, but that we do not yet fully understand these connections. It also suggests that a sole focus on care to promote vaccination may be ineffective, and so perhaps looking at foundations on their own does not provide the full picture.

Increasingly, research on moral values is considering interplays *between* foundations. The moral trade-off hypothesis (Waytz et al., 2013) is an extension of MFT which looks at trade-offs between foundations, that is, differences in endorsement between one foundation relative to another. This work has found that trade-offs between foundations are predictive of attitudes and intended behaviour. Trade-offs between fairness and loyalty predict attitudes towards whistleblowing, with higher concern for fairness over loyalty corresponding to higher inclination to report unethical behaviour (Waytz et al., 2013). Furthermore, higher concern for fairness over authority predicts more supportive judgements towards social justice protests (Monroe et al., 2020), and higher concern for purity over care predicts greater prejudice towards sexual outgroups (Monroe & Plant, 2019). To date, the moral trade-off hypothesis has not been used to consider vaccine attitudes. It may be that the decision processes involved entail balancing competing moral concerns, for example, pro-vaccination concerns to protect others and prevent harm from disease (care), with anti-vaccination concerns around potential contaminants (purity) and limits to freedoms (liberty). Perhaps, individual differences in how care is traded-off against purity and liberty may help better explain vaccination reluctance.

1.2 | Hypotheses

The context of the Covid-19 pandemic presents a unique opportunity to explore these questions during the development and rollout of a new vaccine. Across three studies, we aim to explore moral foundations relevant to attitudes towards Covid-19 vaccination, and whether trade-offs between foundations will predict these attitudes. We hypothesise that higher endorsement of purity and liberty will predict greater reluctance to receive vaccination. We also hypothesise that, though care may not be predictive when considered independently, trade-offs between purity over care and liberty over care will predict greater reluctance to receive Covid-19 vaccination.

2 | STUDY 1

2.1 | Methods

2.1.1 | Participants

A sample of Scottish undergraduate students were recruited online in spring 2021 while the United Kingdom remained in lockdown and key workers, vulnerable people, and those over 60 were being invited to be vaccinated (Scottish Government, 2021). Participants were required to be over 17 and resident in the United Kingdom from January 2020. A minimum target sample size of 160 was identified based on a G*Power analysis for simple regression (fixed model for R^2 deviation from 0) for a small effect ($f^2 = .05$, $\alpha = .05$, $\beta = 0.20$). Exclusion criteria were pre-registered (https://osf.io/z9n6h). Of a total 190 participants recruited, 20 were removed because they did not meet criteria (2 due to incomplete data and under minimum age; and 18 did not pass attention check criteria). A total of 170 participants were included in the final analysis (see Table 1). The three studies in this paper all received ethical approval from the university's Research Ethics Committee.

2.1.2 | Measures

Along with demographic information, participants were required to complete measures of vaccine hesitancy and moral foundations. In addition, we also collected exploratory measures to inform secondary analyses, along with an alternative measure of moral foundation endorsement (see preregistration and the Supporting Information for full information on these measures and secondary analyses).

Covid-19 vaccine reluctance

Reluctance to receive Covid-19 vaccination was measured through the Oxford Covid-19 Vaccine Hesitancy Scale (Freeman et al., 2020). This scale is designed to measure intent to receive vaccination (e.g. 'Would you take a Covid-19 vaccine [approved for use in the United Kingdom] if offered?') and has been validated across a large UK sample (N = 5114, Freeman et al., 2020). The measure contains seven items with item-specific response options, coded from 1 to 5. A 'Don't know' option is provided which is excluded from scoring. Higher mean scores represent higher levels of vaccine hesitancy ($\alpha = .94$).

Moral foundations questionnaire

Endorsement of moral foundations was measured by the 30-item Moral Foundations Questionnaire (Graham et al., 2011) measuring care ($\alpha = .62$), fairness ($\alpha = .65$), loyalty ($\alpha = .67$), authority ($\alpha = .70$) and purity ($\alpha = .73$), as well as a 9-item liberty scale ($\alpha = .53$; Iyer et al., 2012). These scales measure foundation endorsement on six points (0 to 5), with higher scores indicating greater endorsement. Lower internal consistency is not uncommon with the MFQ, and Graham et al. (2011) argue that this reflects a balance between sufficient consistency and comprehensive coverage, building on previous scale development work (Gough, 1979, 1984; John & Soto, 2007). Scores from the MFQ were implemented both as a mean score for each foundation individually, and within trade-off scores taking a difference between foundation scores (liberty – care; purity – care) following an approach in moral trade-off studies (Monroe et al., 2020, Studies 1 and 2; Monroe & Plant., 2019, Study 3).

2.1.3 | Procedure

The Gorilla Experiment Builder (www.gorilla.sc) was used to create and host the study (Anwyl-Irvine et al., 2019). Demographic information was collected first, followed by (in randomised order): Covid-19 measures (in the following order: Vaccine Hesitancy Scale, followed by exploratory variables), and moral value measures (Moral Foundations Questionnaire first before exploratory moral trade-off task).

TABLE 1 Sample demographics for Study 1.

N	Age Mean (*SD*)	Gender N (%)	Location N (%)	Compensation N (%)
170	20.83 (4.0)	Male: 37 (21.9) Female: 127 (75.1) Other: 6 (3.6)	Scotland: 121 (71.6) England: 39 (23.0) Wales: 3 (1.8) N. Ireland: 7 (4.1)	No compensation: 40 (23.5) Course credit: 130 (76.5)

TABLE 2 Study 1 descriptive statistics and correlations for foundation and vaccine reluctance.

	Mean (*SD*)	1	2	3	4	5	6	7	8
1. Care	4.0 (0.6)								
2. Purity	2.0 (1.0)	.06							
3. Liberty	3.2 (0.6)	.12	.18						
4. Loyalty	2.2 (0.8)	.12	.52***	.26**					
5. Authority	2.3 (0.8)	.04	.60***	.29**	.61***				
6. Fairness	3.9 (0.6)	.60***	.00	.11	.05	–.01			
7. Purity – Care	–2.0 (1.1)	–.52***	.82***	.09	.38***	.49***	-.35***		
8. Liberty – Care	–0.8 (0.8)	–.71***	.08	.61***	.09	.17	–.40***	.48***	
9. Vaccine Reluctance	1.6 (.7)	–.21	.24*	.08	.13	.13	–.20	.33***	.23*

*$p < .05$; **$p < .01$; ***$p < .001$.

2.1.4 | Analysis

Analyses with foundations measured on the MFQ are reported here. For all other preregistered analyses, see the Supporting Information. Simple linear regressions were fit with MFQ scores for care, liberty and purity to predict vaccine reluctance. Simple linear regressions were also fit with trade-off scores for liberty versus care and purity versus care predicting vaccine reluctance. Pearson's *r* correlations between MFQ scores and vaccine reluctance are reported and have been corrected for multiple comparisons (Bonferroni). Due to negatively skewed distributions in vaccine hesitancy (skewed towards non-reluctance) in all studies, non-parametric regressions (Kendall–Theil regressions) were conducted alongside the reported parametric testing (see the Supporting Information—results consistent with parametric analyses). All variables were standardised (*z*-scored) before being entered in models, and the standard $p < .05$ criteria for significance was used.

2.2 | Results

Mean vaccine reluctance was relatively low, and thus participants were generally willing to receive Covid-19 vaccination (see Table 2). Of the three foundations relevant to our hypotheses, MFQ scores indicated highest endorsement for care, followed by liberty and then purity (Table 2). Mean trade-off scores were negative reflecting that in general participants endorsed care more than liberty and purity. Purity ($r = .24$, $p = .02$, $R^2 = .06$) on its own correlated with vaccine reluctance, as did the trade-off score between purity and care ($r = .33$, $p < .001$, $R^2 = .11$). Neither care ($r = -.21$, $p = .07$) nor liberty ($r = .08$, $p > .99$) on their own significantly correlated with vaccine reluctance, but the trade-off between them did ($r = .23$, $p = .03$, $R^2 = .05$). Bayes factors were calculated for non-significant correlations to aid interpretation. To interpret these Bayes factors, we apply conventional cut-offs (Jeffreys, 1939/1961; Lee & Wagenmakers, 2014), with values less than 1/3 and less than 1 indicating moderate and anecdotal evidence for the null hypothesis respectively, and values over 1 and over 3 indicating anecdotal and moderate evidence for the alternative hypothesis respectively. Here, Bayes factors indicated anecdotal evidence for the correlation between care and vaccine reluctance ($BF_{10} = 1.90$), and moderate evidence for the null for the correlation between liberty and vaccine reluctance ($BF_{10} = 0.32$).

2.2.1 | Preregistered analyses

To test the hypothesis that higher endorsement of purity and liberty will predict greater reluctance to receive vaccination, simple linear regressions were conducted (see Table 3). Higher endorsement of purity predicted higher vaccine reluctance ($\beta = 0.24$, $F(1, 168) = 10.58$, $p = .001$), however liberty was not significant ($\beta = 0.08$, $F(1, 168) = 1.20$, $p = .27$) and a Bayes factor for this model indicated moderate evidence for the null ($BF_{10} = 0.29$; Jeffreys, 1939/1961; Lee & Wagenmakers, 2014). Furthermore, higher endorsement of care predicted lower reluctance ($\beta = -0.21$, $F(1, 168) = 7.68$, $p = .006$).

Simple linear regressions were also conducted to test the hypothesis that trade-offs (purity vs. care and liberty vs. care) will predict greater reluctance to receive vaccination (see Table 3). Trade-offs were

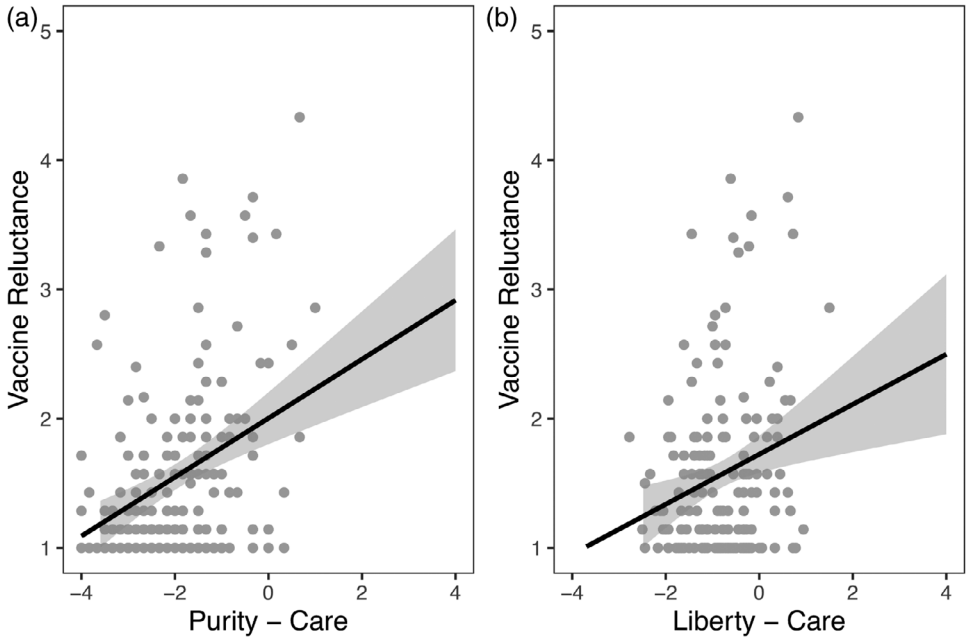

FIGURE 1 Associations between trade-offs and vaccine reluctance in Study 1. Grey areas represent 95% CI boundaries.

TABLE 3 Simple linear regressions predicting vaccine reluctance from foundation scores in Study 1.

	ß	*SE*	95% CI	*p*	R^2
Care	−0.21**	0.08	[−0.36, −0.06]	.006	.04
Purity	0.24**	0.07	[0.10, 0.39]	.001	.06
Liberty	0.08	0.08	[−0.07, 0.24]	.27	.01
Purity – Care	0.33***	0.07	[0.18, 0.47]	<.001	.11
Liberty – Care	0.23**	0.08	[0.08, 0.37]	.003	.05

Note: Coefficients from separate models.
***$p < .01$; ***$p < .001$.

predictive of vaccine reluctance—with each increase in endorsement of purity over care ($\beta = 0.33$, $F(1, 168) = 20.23$, $p < .001$) and liberty over care ($\beta = 0.23$, $F(1, 168) = 9.04$, $p = .003$) predicting an increase in vaccine reluctance (see Figure 1).

2.3 | Discussion

Study 1 indicates that the endorsement of liberty and purity relative to care is predictive of higher levels of vaccine reluctance. Furthermore, higher endorsement of purity and lower endorsement of care considered independently were predictive of greater reluctance, however the endorsement of liberty was not significant here.

There are several methodological limitations to this study. Specifically, Study 1 uses a university student sample, likely to be predisposed towards prioritising more liberal moral values (such as care) relative to more conservative ones (such as purity; Pew Research Centre, 2016), and towards receiving the Covid-19 vaccine (King et al., 2021). In addition, with the expanding rollout of a vaccine during recruitment, we also did not directly capture actual intentions to receive the vaccine. We address these limitations in Study 2, widening out to a general population and including a measure of vaccine intentions.

3 | STUDY 2

3.1 | Methods

3.1.1 | Participants

Recruitment for a general sample commenced in spring 2021, while the vaccination programme was progressing quickly across the United Kingdom and over 50s were beginning to be invited to receive their first vaccination. At this time an easing of lockdown restrictions framework was also released (Institute for Government Analysis, 2021). Recruitment to this sample on Prolific (www.prolific.co) took place in late spring 2021. To replicate effects in Study 1, the minimum target sample size was doubled to 320. Participants recruited on Prolific were compensated £1.70.

A total of 349 participants were recruited. As per preregistered exclusion criteria (https://osf.io/z9n6h), a total of 21 participants were removed (1 under minimum age; 11 did not pass a compliance check and 9 did not pass attention check criteria). The final sample comprised 328 participants (see Table 4).

3.1.2 | Measures

The same measures reported for Study 1 were also used in Study 2 (α's: care = .68; fairness = .64; loyalty = .62; authority = .77; purity = .76;

TABLE 4 Sample demographics for Study 2.

N	Age Mean (*SD*)	Gender N (%)	Location N (%)	Compensation N (%)
328	40.16 (14.5)	Male: 115 (35.0) Female: 210 (64.0) Other: 3 (0.9)	Scotland: 124 (37.8) England: 190 (52.6) Wales: 6 (1.8) N. Ireland: 8 (2.4)	No compensation: 124 (62.2) Payment on Prolific: 204 (38.8)

TABLE 5 Vaccine status categories in Study 2.

Response option	Vaccine status category N (%)
'I have not yet been offered a Covid-19 vaccination and do intend to have one when I am offered it'	Willing to vaccinate 297 (90.6)
'I have been offered a Covid-19 vaccination and do intend to attend my appointment'	
'I have received the first dose of the Covid-19 vaccination and do intend to get the second dose'	
'I have received both the first and second dose of the Covid-19 vaccination'	
'I have not yet been offered a Covid-19 vaccination and do not intend to have one when I am offered it'	Reluctant to vaccinate 21 (6.4)
'I have been offered a Covid-19 vaccination and I have declined my invitation'	
[a]'I have been offered a Covid-19 vaccination and I have delayed my invitation' (*and do not intend to receive vaccination*)	
[a]'I have received the first dose of the Covid-19 vaccination and do not intend to get the second dose'	
[a]'I have been offered a Covid-19 vaccination and I have delayed my invitation' *(Medical reason or no reason given)*	Other 10 (3.0)
[a]'I have received the first dose of the Covid-19 vaccination and do not intend to get the second dose' *(Medical reason or no reason given)*	

[a]Responses to these items were included in the reluctant to vaccinate category only if a text box response indicated that the participant has delayed or did not intend to receive a second dose due to reluctance to receive vaccination. The 'Other' grouping consists of responses not consistent with either category willing or reluctant, and includes response types: delayed without reason provided, delayed and monitoring situation, undecided, no to second dose without reason, delayed without reason, delayed due to allergy.

liberty = .67; vaccine reluctance = .96), with minor changes to instructions for the vaccine reluctance measure to account for the speed of the progressing vaccination programme and acknowledge that some participants may already have received or been invited to receive a vaccine. To account for this, a measure of vaccine status was also completed by participants.

Vaccine status

Participants were asked to choose one of 8 categories to represent their vaccine decision. Responses to vaccine status were used to create a secondary categorical measure of vaccine reluctance (willing, reluctant and other—see Table 5), which will be referred to as vaccine status. An optional text box was included ('If you have declined or delayed your invitation, what are the reasons for this?'). In addition to indicating their vaccine status, participants were also asked to rate their certainty ('How certain are you about your decision?', scored from 1 = *not at all certain* to 4 = *very certain*), and their feelings about that choice ('How do you feel about this decision?', scored from 1 = *very negatively* to 7 = *very positively*)—analyses with these measures are reported in the Supporting Information.

The same procedure and analysis plan for Study 1 was followed. As with Study 1, confirmatory analyses with foundations measured on the MFQ are reported here, along with exploratory analysis to consider reported reluctance to vaccinate in terms of actual vaccine status. For a complete report of preregistered and exploratory analyses, see the Supporting Information.

3.2 | Results

As in Study 1, mean vaccine reluctance was low (see Table 6), and generally participants were willing to receive a Covid-19 vaccine. Participants' vaccine status reflected this, with 90.6% indicating that they intended to or already had received a full course of vaccination. MFQ scores again indicated highest endorsement for care, followed by liberty and then purity, with generally negative trade-off scores reflecting higher endorsement of care over liberty and purity. Unlike Study 1, purity on its own did not correlate with vaccine reluctance ($r = .14$, $p = .12$) and nor did care ($r = -.07$, $p > .99$), while liberty did ($r = .29$, $p < .001$, $R^2 = .08$). Bayes factors indicated moderate evidence for the null for the correlation between care and vaccine reluctance ($BF_{10} = 0.27$), and moderate evidence for the correlation between purity and vaccine reluctance ($BF_{10} = 2.97$; Jeffreys, 1939/1961; Lee & Wagenmakers, 2014).

TABLE 6 Study 2 descriptive statistics and correlations for foundation and vaccine variables.

	Mean (*SD*)	1	2	3	4	5	6	7	8
1. Care	4.0 (.7)								
2. Purity	2.3 (1.0)	.11							
3. Liberty	3.0 (.7)	.15	.20**						
4. Loyalty	2.4 (.8)	.11	.59***	.31***					
5. Authority	2.8 (1.0)	.00	.69***	.18**	.66***				
6. Fairness	3.8 (.6)	.57***	−.01	.07	−.02	−.10			
7. Purity vs. Care	−1.7 (1.2)	−.49***	.81***	.09	.45***	.60***	−.35***		
8. Liberty vs. Care	−1.0 (.9)	−.65***	.08	.65***	.15	.14	−.39***	.45***	
9. Vaccine Reluctance	1.6 (0.9)	−.07	.14	.29***	.07	.02	−.13	.16*	.28***

*$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 7 Simple linear regressions predicting vaccine reluctance from foundation scores in Study 2.

	β	*SE*	95% CI	*p*	R^2
Care	−0.07	0.06	[−0.18, 0.04]	.21	.00
Purity	0.14*	0.05	[0.03, 0.25]	.01	.02
Liberty	0.29***	0.05	[0.19, 0.40]	<.001	.09
Purity vs. Care	0.16**	0.05	[0.05, 0.27]	.003	.03
Liberty vs. Care	0.28***	0.05	[0.17, 0.38]	<.001	.08

*$p < .05$; **$p < .01$; ***$p < .001$.

The trade-off scores for both purity ($r = .16$, $p = .03$, $R^2 = .03$) and liberty ($r = .28$, $p < .001$, $R^2 = .08$) both correlated with vaccine reluctance, with higher endorsement over care corresponding with greater reluctance.

3.2.1 | Preregistered analyses

Simple linear regressions were again conducted to test the hypothesis that higher endorsement of purity and liberty predict greater vaccine reluctance (see Table 7). Higher endorsement of purity ($\beta = 0.14$, $F(1, 326) = 6.45$, $p = .01$) and liberty ($\beta = 0.29$, $F(1, 326) = 30.60$, $p < .001$) predicted higher vaccine reluctance. Care was not significant ($\beta = -0.07$, $F(1, 326) = 1.55$, $p = .21$), and a Bayes factor for this model indicated moderate evidence for the null ($BF_{10} = 0.25$; Jeffreys, 1939/1961; Lee & Wagenmakers, 2014).

As in Study 1, trade-offs were predictive of vaccine reluctance—with increases in endorsement of purity over care ($\beta = 0.16$, $F(1, 326) = 8.81$, $p = .003$) and liberty over care ($\beta = 0.28$, $F(1, 326) = 27.15$, $p < .001$), predicting increased vaccine reluctance (see Figure 2).

3.2.2 | Exploratory analyses

To test whether foundation and trade-offs scores would predict actual vaccine decisions, we fit a series of binary logistic regressions predicting vaccine status. To fit these, we first dropped participants in the 'other' category (N = 10). In models predicting vaccine status, the 'willing' category was implemented as the reference level, so coefficients represent the change in likelihood associated with being reluctant to vaccinate.

Continuous vaccine reluctance significantly predicted vaccination status ($\beta = 2.13$, $SE = 0.33$, 95% CI [1.56, 2.90], $p < .001$, OR = 8.38), with more reluctant individuals more likely to report an intention not to get vaccinated. Models with foundations found that liberty on its own ($\beta = 1.04$, $SE = 0.28$, 95% CI [0.52, 1.61], $p < .001$, OR = 2.82) and in trade-offs with care ($\beta = 0.67$, $SE = 0.20$, 95% CI [0.27, 1.08], $p = .001$, OR = 1.95) predicted how likely participants were to be reluctant to vaccinate, with those with higher endorsement of liberty and greater value of liberty over care more likely to be in the reluctant category. However, models with purity were not significant (p's > .34, see the Supporting Information). Logistic models with corrections for rare events (Firth's method) yielded similar results, however it is worth noting that parameters for logistic regression, even corrected, are known to be biased in smaller samples (King & Zeng, 2001).

3.3 | Discussion

Study 2 replicated findings from Study 1 that the endorsement of purity and liberty relative to care predicted higher levels of vaccine reluctance. In addition, both purity and liberty individually predicted vaccine reluctance in Study 2. In exploratory analyses of reported vaccine decisions, individuals with higher concern for liberty on its own, and in trade-off with care, were more likely to be reluctant to receive a vaccine.

It is important to interpret these findings in light of the fact that the majority of participants across both studies were willing to be vaccinated and only a small proportion of participants did not intend to accept a Covid-19 vaccine. Data for both Study 1 and Study 2 were collected in the early phases of the vaccine rollout in 2021, when public uptake was high. It is not clear whether these findings will sustain over time as uptake drops off, or whether they generalise to more reluctant

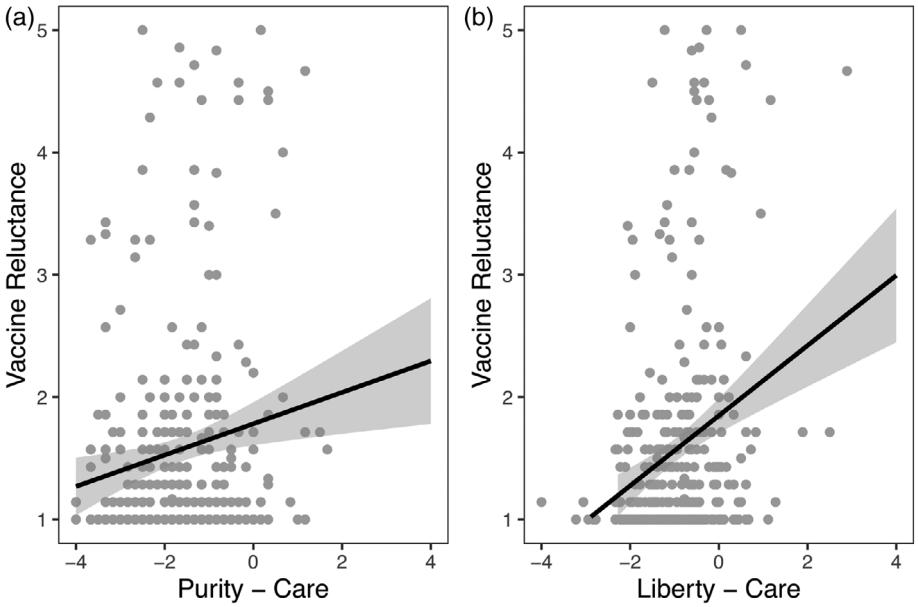

FIGURE 2 Associations between trade-offs and vaccine reluctance in Study 2. Grey areas represent 95% CI boundaries.

individuals, though those who fall into this category may also be more likely to opt out of studies like this one due to perceived biases and mistrust in the scientific community. To explore whether these results sustain over time in Study 3, we replicate these analyses with data collected in 2023, 2 years into the Covid-19 vaccination programme.

4 | STUDY 3

4.1 | Methods

4.1.1 | Participants

Recruitment took place in winter/spring 2023. Up until this point in the United Kingdom, there have been three primary doses of the Covid-19 vaccine offered across 2021 and early 2022, as well as a series of seasonal booster vaccines starting from autumn 2022 (Scottish Parliament Information Centre, 2023; NHS England, 2023), with a subset of these only offered to specific vulnerable groups.

Recruitment took place via social media and on Prolific. A G*Power analysis indicated a target sample size of N = 395 for a linear regression with 1 predictor (fixed model for R^2 deviation from 0) for a small effect ($f^2 = .02, \alpha = .05, \beta = 0.20$). Participants recruited on Prolific were compensated £1.10. A total of 398 participants were recruited. As per preregistered exclusion criteria (https://osf.io/3krz5), a total of 10 participants were removed (did not pass attention check). The final sample comprised 388 participants (see Table 8).

4.1.2 | Measures

Measures in Study 3 included the same measures reported for Study 1 and 2 (α's: care = .67; fairness = .65; loyalty = .69; authority = .74; purity = .79; liberty = .68; vaccine reluctance = .96). As in Study 2, minor changes were made to instructions for the vaccine reluctance measures to account for the current context of the vaccination programme.

The measure of vaccine status used in Study 2 was adapted to include one set of questions about primary doses of the Covid-19 vaccine delivered between 2021 and early 2022 (see Table 9), as well as a second set of questions asking about booster doses and ongoing intention to receive these (see Table 10). Responses were used to create categorical variables for vaccination status (willing, reluctant and other). Participants in the 'other' category for either the primary dose or the booster dose were dropped (N = 30) from logistic regressions predicting vaccination status.

Participants were also asked to report regret about the primary doses ('How much do your regret your decision about the primary dose of the Covid-19 vaccine?', scored from 1 = *no regret whatsoever* to 4 = *fully regret*), along with certainty and feelings about their booster dose decisions (similar to items used in Study 2). These items were used in exploratory analyses (see the Supporting Information).

Analyses were preregistered (https://osf.io/3krz5) and consistent with those reported for Study 1 and 2. Some exploratory analyses have been reported in the Supporting Information.

4.2 | Results

Mean vaccine reluctance differed across studies ($F(2, 883) = 81.90$, $p < .001$)—though there was no difference between Study 1 and 2 ($\beta = 0.00$, $p > .99$), vaccine reluctance in Study 3 was higher ($\beta = 0.80$, $p < .001$). In Study 3, most participants had been willing to receive the primary doses of the Covid-19 vaccine, with 76.8% indicating they had received all that they had been eligible for. Compared to primary doses, a lower proportion of participants indicated that they had received—or

TABLE 8 Sample demographics for Study 3.

N	Age Mean (*SD*)	Gender N (%)	Location N (%)	Compensation N (%)
388	38.31 (14.7)	Male: 120 (30.9) Female: 259 (66.8) Other: 9 (2.3)	Scotland: 151 (38.9) England: 215 (55.4) Wales: 11 (2.8) N. Ireland: 11 (2.8)	No compensation: 146 (37.6) Payment on Prolific: 242 (62.4)

TABLE 9 Vaccine status categories for primary dose in Study 3.

Response option	Vaccine status category N (%)
'I have received all primary doses of the Covid-19 vaccine that I have been eligible for (1st and 2nd dose (and 3rd if applicable))'	Willing to vaccinate 298 (76.8)
'I have received the first two primary doses of the Covid-19 vaccine (1st and 2nd dose) and was eligible for an additional dose (3rd dose) but decided against receiving it'	Reluctant to vaccinate 64 (16.5)
'I have received the first primary dose of the Covid-19 vaccine but decided against further doses (2nd dose (and 3rd if applicable))'	
'I decided against receiving any primary doses of the Covid-19 vaccine (1st and 2nd dose (and 3rd if applicable))'	

Note: Other category comprised 26 participants (6.7%) who gave response where a concrete reason was indicated for a vaccine decision, such as a pre-existing medical condition, caring responsibilities, or a work-related requirement.

TABLE 10 Vaccine status categories for booster doses in Study 3.

Response option	Vaccine status category N (%)
'I have received all booster doses of the Covid19 vaccine and if more are offered to me I DO intend to receive them'	Willing to vaccinate 217 (55.9)
'I have received some booster doses of the Covid-19 vaccine and if more are offered to me I DO intend to receive them'	
'I have not received any booster doses of the Covid-19 vaccine—but if more are offered to me I DO intent to receive them'	
'I have received all booster doses of the Covid-19 vaccine—but if more are offered to me I DO NOT intend to receive them'	Reluctant to vaccinate 166 (42.8)
'I have received all booster doses of the Covid-19 vaccine—but if more are offered to me I AM UNSURE if I would receive them'	
'I have received some booster doses of the Covid-19 vaccine—but if more are offered to me I DO NOT intend to receive them'	
'I have received some booster doses of the Covid-19 vaccine—but if more are offered to me I AM UNSURE if I would receive them'	
'I have not received any booster doses of the Covid-19 vaccine and if more are offered to me I DO NOT intend to receive them'	
'I have not received any booster doses of the Covid-19 vaccine and if more are offered to me I AM UNSURE if I would receive them'	

Note: 'Other' category comprised five participants (1.3%) who gave response where a concrete reason was indicated for a vaccine decision, such as a pre-existing medical condition, caring responsibilities, or a work-related requirement.

intended to receive—booster doses of the vaccine, with 55.9% indicating that they had received all booster doses they had been eligible for and intended to receive any further booster doses. As with Study 1 and 2, mean trade-off scores were negative, reflecting higher endorsement of care relative to liberty and purity (see Table 11). Both purity ($r = .24$, $p < .001$, $R^2 = .06$) and liberty ($r = .30$, $p < .001$, $R^2 = .09$) positively correlated with vaccine reluctance, while care correlated negatively ($r = -.18$, $p = .003$, $R^2 = .03$). The trade-off scores for both purity

TABLE 11 Study 3 descriptive statistics and correlations for foundation and vaccine variables.

	Mean (*SD*)	1	2	3	4	5	6	7	8
1. Care	4.0 (.7)								
2. Purity	2.3 (1.0)	.20***							
3. Liberty	3.2 (.7)	.16*	.36***						
4. Loyalty	2.4 (.9)	.27***	.57***	.35***					
5. Authority	2.7 (.9)	.21***	.71***	.40***	.73***				
6. Fairness	3.9 (.6)	.69***	.09	.15*	.18**	.11			
7. Purity vs. Care	−1.7 (1.1)	−.41***	.81***	.24***	.37***	.54***	−.33***		
8. Liberty vs. Care	−.8 (.9)	−.66***	.12	.64***	.05	.14*	−.43***	.51***	
9. Vaccine Reluctance	2.4 (1.2)	−.18**	.24***	.30***	−.02	.11	−.21***	.33***	.37***

*$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 12 Simple linear regressions predicting vaccine reluctance from foundation scores in Study 3.

	ß	*SE*	95% CI	*p*	R^2
Care	−0.18***	0.05	[−0.28, −0.08]	<.001	.03
Purity	0.24***	0.05	[0.15, 0.34]	<.001	.06
Liberty	0.30***	0.05	[0.21, 0.40]	<.001	.09
Purity vs. Care	0.33***	0.05	[0.24, 0.43]	<.001	.11
Liberty vs. Care	0.37***	0.05	[0.28, 0.46]	<.001	.14

****$p < .001$.

($r = .33$, $p < .001$, $R^2 = .11$) and liberty ($r = .37$, $p < .001$, $R^2 = .14$) also correlated with vaccine reluctance, with higher endorsement over care corresponding with greater reluctance.

4.2.1 | Preregistered analyses

Simple linear regressions (see Table 12) found that higher endorsement of purity ($\beta = 0.24$, $F(1, 386) = 24.50$, $p < .001$) and liberty ($\beta = 0.30$, $F(1, 386) = 39.26$, $p < .001$) predicted higher vaccine reluctance (see Table 12). Care was also significant ($\beta = -0.18$, $F(1, 386) = 12.71$, $p < .001$). As in Study 1 and 2, trade-offs were predictive of vaccine reluctance—with each increase in endorsement of purity over care ($\beta = 0.33$, $F(1, 386) = 48.20$, $p < .001$) and liberty over care ($\beta = 0.37$, $F(1, 386) = 61.70$, $p < .001$), predicting greater vaccine reluctance (see Figure 3).

Furthermore, it was hypothesised that trade-off scores would predict vaccine reluctance better than the individual purity and liberty foundations on their own. To test this, hierarchical regressions were fit to compare models with purity or liberty alone to ones with both the individual foundations and their trade-offs with care. A model with the purity versus care trade-off improved over a model with purity alone, $F(1, 385) = 23.16$, $p < .001$. The same was true for liberty: the liberty versus care trade-off improved over liberty alone, $F(1, 385) = 23.99$, $p < .001$ (see the Supporting Information for full report of hierarchical regressions).

4.2.2 | Exploratory analyses

As in Study 2, in logistic regressions predicting vaccine status, the 'willing' categories were implemented as the reference levels, so coefficients represent the change in likelihood of being reluctant to vaccinate. For the primary doses, vaccine reluctance significantly predicted vaccination status ($\beta = 1.78$, $SE = 0.20$, 95% CI [1.41, 2.21], $p < .001$, OR = 5.95), with more reluctant individuals more likely to have been reluctant to receive a primary dose. Liberty on its own ($\beta = 0.60$, $SE = 0.16$, 95% CI [0.29, 0.92], $p < .001$, OR = 1.82) and in trade-offs with care ($\beta = 0.60$, $SE = 0.15$, 95% CI [0.32, 0.89], $p < .001$, OR = 1.82) predicted how likely participants were to be reluctant to vaccinate. Furthermore, a model with the liberty versus care trade-off improved over a model with liberty alone, $\chi^2(1, 355) = 5.48$, $p = .02$. Purity on its own ($\beta = 0.40$, $SE = 0.14$, 95% CI [0.13, 0.69], $p = .005$, OR = 1.50) and in trade-offs with care ($\beta = 0.55$, $SE = 0.15$, 95% CI [0.26, 0.87], $p < .001$, OR = 1.73) also predicted vaccine reluctance and, as with liberty, a model with the purity versus care trade-off improved over a model with purity alone, $\chi^2(1, 355) = 5.87$, $p = .02$.

For the booster doses (and ongoing intention to receive future boosters), vaccine reluctance also significantly predicted vaccination status ($\beta = 3.50$, $SE = 0.38$, 95% CI [2.82, 4.32], $p < .001$, OR = 33.24). The same pattern of results was found with liberty on its own ($\beta = 0.46$, $SE = 0.12$, 95% CI [0.24, 0.70], $p < .001$, OR = 1.59) and in trade-offs with care ($\beta = 0.64$, $SE = 0.13$, 95% CI [0.40, 0.89], $p < .001$, OR = 1.89), and the liberty versus care trade-off again improved over a model with liberty alone, $\chi^2(1, 355) = 13.80$, $p < .001$. The same pattern was also found with purity on its own ($\beta = 0.32$, $SE = 0.11$, 95% CI [0.10, 0.54], $p = .004$, OR = 1.37) and in trade-offs with care ($\beta = 0.50$, $SE = 0.12$, 95% CI [0.28, 0.74], $p < .001$, OR = 1.65), and as with liberty, the purity versus care trade-off improved over a model with purity alone, $\chi^2(1, 355) = 13.22$, $p < .001$. See the Supporting Information for a full report

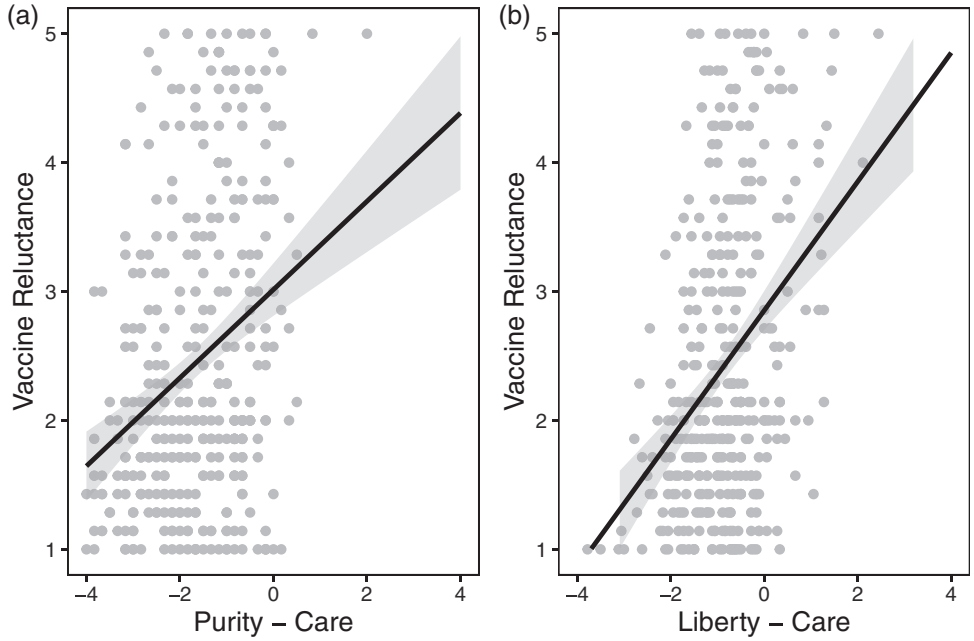

FIGURE 3 Associations between trade-offs and vaccine reluctance in Study 3. Grey areas represent 95% CI boundaries.

of logistic models. Logistic models for trade-off scores with corrections for rare events (Firth's method) yielded similar results.

4.3 | Discussion

Study 3 replicated findings from Study 1 and 2, with trade-offs of purity and liberty relative to care predicting higher levels of vaccine reluctance. As in Study 2, both purity and liberty on their own predicted vaccine reluctance. Also, as in Study 2, liberty and its trade-off with care predicted actual vaccine decisions, both about the primary doses of the Covid-19 vaccine, and ongoing intention regarding booster doses. Furthermore, in Study 3 this pattern was also found with purity. Finally, across these results, trade-off scores improved over purity or liberty on their own as predictors of vaccine reluctance.

5 | GENERAL DISCUSSION

Across three studies, we hypothesised that higher endorsement of purity and liberty would predict greater reluctance to receive Covid-19 vaccination. These foundations have been identified most often in previous research on moral foundation endorsement and vaccine hesitancy (Amin et al., 2017; Luz et al., 2019; Heine & Wolters, 2021; Nan et al., 2022), though not consistently. We also hypothesised that, though care may not be predictive when considered independently as has been found in some previous studies (Amin et al., 2017; Heine & Wolters, 2021), trade-offs between purity and liberty relative to care would predict greater Covid-19 vaccine reluctance.

In all three studies, purity consistently predicted vaccine reluctance—higher endorsement of purity corresponded with higher reluctance. However, liberty and care, were less consistent, with care but not liberty predicting vaccine reluctance in Study 1, liberty but not care in Study 2 (though in both these studies, null results were inconclusive) and in Study 3, both care and liberty were predictive of vaccine reluctance. Where effects with these foundations were seen, higher endorsement of liberty was related to greater reluctance to receive the vaccine, while higher endorsement of care was related to lower reluctance. The discrepancies across these studies are in keeping with other studies that have examined the role of moral foundations, considered individually, in vaccine hesitancy. Prior research found highest concern for purity and liberty for parents who are medium and highly vaccine hesitant (Amin et al., 2017). However, when used in government communication, authority and liberty were found to boost parental uptake, with smaller and inconsistent results for purity (Heine & Wolters, 2021). Though some prior research has found connections with care (Nan et al., 2022), others have found that concern for care on its own did not significantly predict vaccine hesitancy or uptake (Amin et al., 2017; Heine & Wolters, 2021).

Across all three studies, trade-offs between purity and liberty relative to care predicted greater reluctance to receive a Covid-19 vaccine more consistently than considering foundations on their own. Furthermore, liberty on its own and in trade-off with care was also predictive of actual decisions about the primary doses of the vaccine (Study 2 and 3), as well as ongoing intention to take up booster doses (Study 3). In Study 3, we also found this pattern of results with purity and its trade-off with care.

This work suggests that considering how values are traded-off against one another may prove more helpful in explaining vaccine decisions. There are a number of different moral concerns that are relevant for vaccine uptake, some of which are in tension with one another. Pro-vaccination messaging tends to emphasise protecting oneself and

others from harm from disease (e.g. GOV.UK, 2021). On the other hand, anti-vaccination rhetoric tends to emphasise vaccines as unnatural, unknown or dangerous contaminants; and/or advocate personal freedoms, alongside suspicion of government and pharmaceutical agendas. Previous research has shown that trade-offs between moral foundations relate to a number of social and political attitudes and judgements where multiple moral values appear in tension (Waytz et al., 2013; Monroe & Plant, 2019; Monroe et al., 2020). Our findings indicate that Covid-19 vaccine attitudes present a further context in which this framework is useful.

Furthermore, these three studies show that these patterns are sustained across the development of a vaccine: at the beginning of the rollout when most people were not able to receive it (Study 1); during the first phases of the vaccination programme whilst people were deciding to receive it (Study 2); and 2 years into the programme (Study 3), when the pandemic is largely perceived to be over and the Covid-19 vaccine is becoming a seasonal vaccine, similar to the flu shot. This has relevance both for ongoing understanding of uptake of the Covid-19 vaccine specifically, as well as for wider understanding of vaccine uptake.

There are a number of limitations to the present study. First, this research is entirely correlational and therefore we are unable to infer causal relationships. Indeed, some have called the causal direction of the proposed relationship between moral foundations and social and political attitudes into question (e.g. Strupp-Levitsky et al., 2020; Kugler et al., 2014; Hatemi et al., 2019). Researchers have also begun to explore interventions relevant for Covid-19 vaccine hesitancy (Fishman et al., 2022; Lu & Sun, 2022; Eitze et al., 2021; Joslyn et al., 2023). Future work could draw from these approaches as well as experimental work looking at effects of moral foundations on attitudes and behaviour (e.g. Smetana & Vranka, 2021; Wolsko, 2017; Nilsson et al., 2016), as work on the mechanisms of both moral judgement and vaccine decision-making develops.

In addition, we rely here on the 30-item Moral Foundations Questionnaire and use it to derive the trade-off measures used in these studies. As a self-report survey, the MFQ measures foundations independently item-by-item and so does not provide a direct measure of trade-offs between foundations. While other studies interested in the moral trade-off hypothesis have followed a similar approach to that here (e.g. Monroe et al., 2020, Studies 1 and 2; Monroe & Plant., 2019, Study 3), they have also applied alternative ways of implementing trade-offs, such as writing prompts to invoke one foundation over another (Waytz et al., 2013; Monroe et al., 2020, Studies 2 and 3). Future work may benefit from exploring similar approaches.

Furthermore, this version of the MFQ has come under criticism with concerns about its factor structure (e.g. Zakharin & Bates, 2021; Smith et al., 2017; Hatemi et al., 2019; Iurino & Saucier, 2018), though it remains the most widely utilised measure of moral foundations. This has also been related to criticisms of Moral Foundations Theory itself, particularly with regard to the nature and number of moral values, with some of these critiques putting forward alternative theories and structures of morality (e.g. Morality as cooperation: Curry at al., 2019; Theory of Dyadic Morality: Schein & Gray, 2018; Schein & Gray, 2015). As work on the nature of morality develops, future work could explore these alternative theories in relation to vaccine reluctance.

6 | CONCLUSION

Vaccine reluctance is recognised as a substantial global problem and continued vaccination programmes will form a key part of managing public health, for Covid-19 specifically and for containing the spread of other diseases. Vaccine reluctance is contributed to by a range of complex and contextual factors, and developing better understanding of these could aid in minimising decisions to delay or refuse vaccination. We have explored moral values as one such factor and show that vaccine reluctance is related to how people trade-off conflicting moral values against one another, rather than only considering the role of individual moral concerns on their own. We hope these findings can contribute to future work to inform public messaging to better address these tensions.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in OSF at https://osf.io/tn652/

ETHICS STATEMENT

This research received ethical approval from the Social Sciences School Research Ethics Committee at the University of Dundee.

TRANSPARENCY STATEMENT

Data and supplemental information are publicly available online in Open Science Framework at https://doi.org/10.17605/OSF.IO/TN652

INFORMED CONSENT STATEMENT

All participants gave their written informed consent prior to study inclusion.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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