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Vaccination Invitations Sent by Warm and Competent Medical Professionals Disclosing Risks and Benefits Increase Trust and Booking Intention and Reduce Inequalities Between Ethnic Groups

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Objective: We aim to identify vaccination invitations that foster trust and improve vaccination uptake overall, especially among ethnic minority groups who are more at risk from coronavirus disease (COVID-19) and less likely to be vaccinated. ***Method:*** In a preregistered 4×4 mixed-design experiment, we manipulated how much risk–benefit information the message included within-subjects and the message source between-subjects ($N = 4,038$ U.K. and U.S. participants, 50% ethnic minority). Participants read four vaccine invitations that varied in vaccination risk–benefit information (randomized order): control (no information), benefits only, risk and benefit, and risk and benefit that mentions vulnerable groups. The messages were sent by one of four sources (random allocation): control (health institution), medical professional (unnamed), warm and competent medical professional (unnamed), and named warm and competent medical professional (Sanjay/Lamar). Participants assessed how much they trusted the message and how likely they would be to book their vaccination appointment. ***Results:*** Information about vaccination benefits and risks increased trust, especially among ethnic minority groups—for whom the effect replicated within each group. Trust also increased when the message was sent by a warm and competent medical professional relative to a health institution, but the importance of the source mattered less when more information was shared. ***Conclusions:*** Our research demonstrates the positive impact of outlining the benefits and disclosing the risks of COVID vaccines in vaccination invitation messages. Having a warm and competent medical professional source can also increase trust, especially where the message is limited in scope.

Public Significance Statement
Vaccination invitations can be tailored to increase trust and booking intention. Disclosing vaccine risks in addition to benefits secures more trust and booking intentions (vs. no information), especially for people from U.K. and U.S. ethnic minority groups. Invitations sent by warm and competent medical professionals increased trust and vaccination booking intentions relative to messages sent by a health institution (e.g., the National Health Service in the United Kingdom).

The coronavirus disease (COVID-19) vaccine booster was rolled out to the whole population in the United Kingdome and the United States at the end of 2021, but it was not received with the same enthusiasm as the first vaccination protocol (Our World in Data, 2024). Vaccine engagement also varied across countries and socioeconomic groups. Despite being at higher risk from COVID-19 infection (CDC, 2022; ONS, 2021; Williamson et al., 2020), members of many ethnic minority groups in the United Kingdom and the United States express greater vaccine hesitancy and are more likely to delay or refuse the vaccine than their White counterparts (Gaughan et al., 2022; Kriss et al., 2022; Nguyen et al., 2022; ONS, 2022). For example, in July 2022, the vaccination rate for minority group members in the United States was 11% below that of their White counterparts (ONS, 2022), and this vaccination gap persisted after controlling for sociodemographic factors, including age, gender, religiosity, education, deprivation, and health conditions (Gaughan et al., 2022; Nguyen et al., 2022). In particular, vaccination uptake has been lower in Asian minority groups in the United Kingdom (Hussain et al., 2022) and Black Americans in the United States (Padamsee et al., 2022), while other groups showed smaller differences relative to the White majority, like U.S. Asian (Nguyen et al., 2022), or differences that diminished over time (e.g., Hispanics in the United States; Kriss et al., 2022). In this project, we designed and tested vaccination invitation text messages to raise trust and reduce the vaccine trust gap between ethnic majority groups and the White majority in the United Kingdom and the United States.

People from ethnic minority groups have less trust in health information shared by governments, the health system, and health professionals (Hussain et al., 2022) than the White majority, making them more impervious to health advice. For example, people from ethnic minority groups are more likely to believe that health organizations have nefarious, manipulative intentions, making them less likely to follow their advice (Allington et al., 2023). Hence, despite mass public awareness campaigns in the United States and the United Kingdom highlighting COVID-19 vaccine safety, inaccurate beliefs about vaccine risks are especially high among many minority communities, contributing to significant vaccine skepticism (Hussain et al., 2022; Kamal et al., 2021).

According to the sociocognitive dual-factor model of trust one needs to demonstrate both competence and warmth to be trustworthy (Fiske & Dupree, 2014). Competence refers to the expertise of a person in the area in which they give advice. Warmth refers to their perceived intentions to use their expertise in the recipient's interest—that is, the extent to which they care about and respect the recipient. Applying this model to enhance trust in health communication, we hypothesize that vaccination invitations incorporating transparent, comprehensive risk–benefit information, delivered by a competent and warm source, will be perceived as more trustworthy. We anticipate that this approach will be particularly advantageous for individuals belonging to ethnic minority groups in the United Kingdom and the United States because they tend to hold a less favorable perception of vaccine benefits and risks (Hussain et al., 2022) and exhibit reduced trust in health institutions compared to the White majority (Charura et al., 2022).

How Sharing Vaccine Information Might Raise Trust and Vaccination Intention

To demonstrate their trustworthiness, medical advisors should share all the relevant information patients need to empower them to make an informed decision (Coulter et al., 1999). Sharing plain and accurate vaccine information signals the competence of the advisor, but also their warmth because it demonstrates honesty and respect to the patients, by allowing them to make their own decision (Lencucha & Bandara, 2021). In contrast, withholding relevant health information is not only a breach of International Health Regulations (WHO, 2008) but also a breach of trust. Withholding pertinent information corroborates and fuels conspiratorial beliefs that powerful institutions are hiding the truth, reinforcing distrust and vaccination hesitancy (Allington et al., 2023). Relative to patients being uncertain or relying on incorrect information, receiving trustworthy vaccine information is also expected to shape vaccination intention, but the direction and magnitude of this effect depend on what information is shared.

Communicating the benefits of vaccines is expected to have positive effects on vaccination intention, although different ways to assert benefits vary in their effectiveness (Freeman et al., 2021; Hallsworth et al., 2021; Palm et al., 2021). For example, sharing information about the direct health benefits of vaccines or prosocial motives, such as protecting others or shortening the duration of behavioral restrictions, increased vaccination intentions (Hallsworth et al., 2021). Research conducted in the United States also showed that invitation messages, including vaccine efficacy information, were more effective than control messages without information, while messages emphasizing social norms or political reasons did not differ from the no-information control messages (Palm et al., 2021). Furthermore, emphasizing the personal or collective benefits—or both—of being vaccinated did not affect U.K. residents' vaccination intentions (Freeman et al., 2021). The perceived value of the vaccine in reducing COVID symptoms was insufficient, possibly because vaccine hesitancy was motivated by the belief that COVID was not a threat (Jennings et al., 2021). Hence, to maximize the impact of communications about the

COVID-19 vaccine, the perceived benefits of the vaccine might need to be described relative to the severity of the illness.

It might be tempting to omit risk information and share only the benefits of vaccines for maximal persuasion—indeed, reading about vaguely worded vaccine risks is associated with lower vaccination intention (Petersen et al., 2021; Thorpe et al., 2022). However, evidence suggests that communicating vaccine risks is essential for building trust and makes it more likely that people remain open to information from the same source in the future (Petersen et al., 2021). We also posit that there are conditions in which communicating vaccine risks might raise vaccination acceptance, in contrast with work showing it has a negative effect (Petersen et al., 2021; Thorpe et al., 2022). Given the negative association between vaccine risk perception and vaccination intention (Aw et al., 2021; Callaghan et al., 2021), communicating risk can logically be expected to raise vaccination when it corrects risk perceptions downward. While adverse side effects from COVID vaccines have occurred, the overall risk is low, the side effects are mostly mild, and the overall benefits of the vaccine outweigh those risks (WHO, 2022). The low risk of adverse side effects can also be related to the higher risk from COVID to reinforce that, on balance, choosing the vaccine is the safest option. Overall, precise wording that clarifies the risks are low and how the risks of COVID are superior should raise trust, correct risk overestimations, and convince people to get vaccinated.

In the case of COVID, risks and benefits do not apply equally to everyone and can be more accurately described for specific groups (Williamson et al., 2020). Accurate messages about the risks and benefits of COVID vaccines should acknowledge that some groups are at higher risk from COVID and hence will derive greater benefits from the vaccine. People are well aware that older adults are at higher risk (Holford et al., 2022), but many people do not know this to be the case for those belonging to ethnic minority groups. Based on pretest data, we found that about 50% of the participants did not think ethnic minority groups were at higher risk from COVID, whereas 98% recognized that to be the case for older adults ($N = 1,143$; see Section A in the online supplemental materials).

Information From a Competent and Warm Source Will Raise Trust and Vaccination Intention

The persuasive power of a message depends on its source (Chen, 2015). The sociocognitive dual-factor model of trust (Fiske & Dupree, 2014) can also be applied to the messenger: A competent and warm source should be perceived as more trustworthy (Thorpe et al., 2020). During the pandemic, vaccination invitations often came from institutions—impersonal sources—such as the National Health Service (NHS) in the United Kingdom (GOV.UK, 2021) and pharmacy chains such as CVS Pharmacy or Walmart pharmacies in the United States (Milkman et al., 2021); this might be especially detrimental to people who have low trust in the health system since powerful health institutions are more likely to be expected to have nefarious intentions (Allington et al., 2023). We propose that a message would be better received if it came from a local medical professional who are typically perceived as caring and competent (Katzman & Katzman, 2021). Family physicians (general practitioners in the United Kingdom) are one of the most trusted professionals (Ipsos MORI, 2022)—although this trust varies across ethnic groups.

Highlighting the competence and warmth of the medical professional should bolster their perceived trustworthiness (Fiske &

Dupree, 2014). Indeed, past research shows that it is possible to raise trust in a family physician by showcasing their competence (e.g., has the relevant expertise, is prepared) and warmth (e.g., makes eye contact, considers their needs; Thorpe et al., 2020). This heightened trust in the medical professional resulted in increased advice taking, including vaccination intention (Juanchich et al., 2023).

Naming the medical professional could increase the perceived warmth of the medical professional relative to anonymity, too. Disclosing one's name to people unlocks a new level of connection (Charness & Gneezy, 2008; Kogut & Ritov, 2005). For example, naming a victim increased people's empathy and intention to donate (Kogut & Ritov, 2005), and trust game players entrusted more money to a named partner than to an anonymous one (Charness & Gneezy, 2008). In addition, research on in-group preference (Tajfel, 1982) shows that people trust in-group members more than out-group members (Balliet et al., 2014). Consistently with this, the stereotype content model posits that in-group members are perceived as being warmer and more competent (the two conditions of trustworthiness) than out-group members (Cuddy et al., 2008). Therefore, a source whose name suggests they belong to an ethnic minority group can be expected to be more effective in raising trust in members of ethnic minorities. In line with this, key Western health organizations, like the National Institute of Health Research, recommend leveraging in-group preference to curb vaccine skepticism within ethnic minority groups by including group members advocating for the vaccine in health communications (e.g., Kamal et al., 2021). Yet, the benefits of using in-group source members to promote vaccines have yet to be documented.

Research Goals

Vaccination invitation text messages are an essential tool for successful vaccination campaigns (Phillips et al., 2014). We aim to identify vaccination invitations that foster trust and improve vaccination uptake, particularly among ethnic minority groups who trust the system the least and might need vaccination the most. To do so, we tested the following hypotheses.

Risk–Benefit Information Hypothesis: Communicating Vaccines' Risks and Benefits (vs. No Information) Will Increase Trust and Vaccination Booking Intentions. Vaccination invitations, including vaccination risks and benefits information, will increase trust in the message and vaccination booking intentions. More specifically, we expected that relative to a no risk–benefit information control message, the addition of (Hypothesis 1a [H1a]) benefits, (Hypothesis 1b [H1b]) benefits and risks, and (Hypothesis 1c [H1c]) benefits and risks for specific groups (including ethnic minority groups) would each provide an increment in trust in the message and vaccination booking intention.

Information Source Hypothesis: Messages That State a Medical Professional (vs. a Health Institution) as a Source Will Increase Trust and Vaccination Booking Intentions. Vaccination invitations sent by a medical professional will increase trust in the message and vaccination booking intention—especially when their competence and warmth are highlighted. More specifically, we expected that relative to a health institution, using a source that is a (Hypothesis 2a [H2a]) warm medical professional (unnamed), (Hypothesis 2b [H2b]) warm and competent medical professional (unnamed), and (Hypothesis 2c [H2c]) warm and competent medical professional named (Sanjay/Lamar), would each provide an increment of trust in the message and vaccination booking intention.

Ethnic Group Moderator Hypothesis: Vaccine Risk–Benefit Information and Information Source Will Especially Matter for People From Ethnic Minority Groups. The positive effect of the risk–benefit information and source on trust and booking intention will be greater for people from ethnic minority groups in the United Kingdom and the United States than for the White majority.

To test our risk–benefit information hypothesis, we compared a no risk–benefit control vaccination invitation message to (H1a) a message that covers vaccine benefits, (H1b) a message that covers benefits and risks, and (H1c) a message that covers benefits and risks and mentions groups at higher risks, including ethnic minority groups. To test our information source hypothesis, we compared a control health institution source (NHS/CVS) to three sources: (H2a) a medical professional (unnamed), (H2b) a warm and competent medical professional (unnamed), and finally, (H2c) a named warm and competent medical professional (Sanjay/Lamar). To test our hypothesis that the risk–benefit information and source manipulation would especially benefit people from ethnic minority groups (Hypothesis 3), we conducted our study on a U.K. and U.S. sample of 4,038 participants where half of the respondents belonged to ethnic minority groups, and half to the White majority.

Open Science Statement

The study design, materials, and sample size were preregistered on the international database ClinicalTrials.gov (NCT05238428) and on AsPredicted, which also includes preregistered analyses (86451). The preregistrations, study materials, data, and code for the analyses are available on the Open Science Framework (https://osf.io/8waer/) (Juanchich, 2023). The study was approved by the ethics board of the corresponding author's institution.

Method

Participants

The study took place in February 2022, few months after COVID-19 booster vaccinations became widely available (in December 2021 in the United Kingdom and November 2021 in the United States). The United Kingdom and the United States offered a booster vaccine dose "to every adult over 18 who has had a second dose of the vaccine" in response to the waning effectiveness of primary COVID-19 vaccines and the rapid spread of the new, more contagious omicron variant. It was also widely shared that a booster might be needed annually, making booster vaccine invitations relevant even for people who had already received one booster.

Overall, 4,038 participants invited by Qualtrics completed the study (2,020 U.K. and 2,018 U.S. residents). Across both countries, 80% of the respondents had received their first COVID vaccination(s), but uptake was higher among the U.K. participants (90%) compared to U.S. participants (77%). Overall, 56% of participants had received their booster, which was being offered to all adults at the time, but the booster vaccination rate was higher in the United Kingdom (67%) than in the United States (46%). To test if our messages could reduce the gap in trust between ethnic minorities and the White majority, we aimed to select a sample with about 50% White British/Americans and 50% belonging to ethnic minorities. Our samples ultimately included 43% and 51% ethnic minorities in the U.K. and U.S. subsamples, respectively—see the breakdown in Table SM4 in the online supplemental materials).

We used quota sampling to achieve an age and gender balance that broadly matched the representation of the adult population in the United Kingdom and the United States. Participants' ages ranged from 18 to 91, with a mean age of 45.71 ($SD = 17.02$). Around half of the participants self-identified as men (48%, $n = 1,943$), and the other half as women (51%, $n = 2,063$), with 1% self-identifying as nonbinary ($n = 26$) and 0.1% not identifying with the options available ($n = 6$). A full sample description, including political affiliation, employment, religion, income, fluency in English, and social media use, is available in Section B in the online supplemental materials.

Design

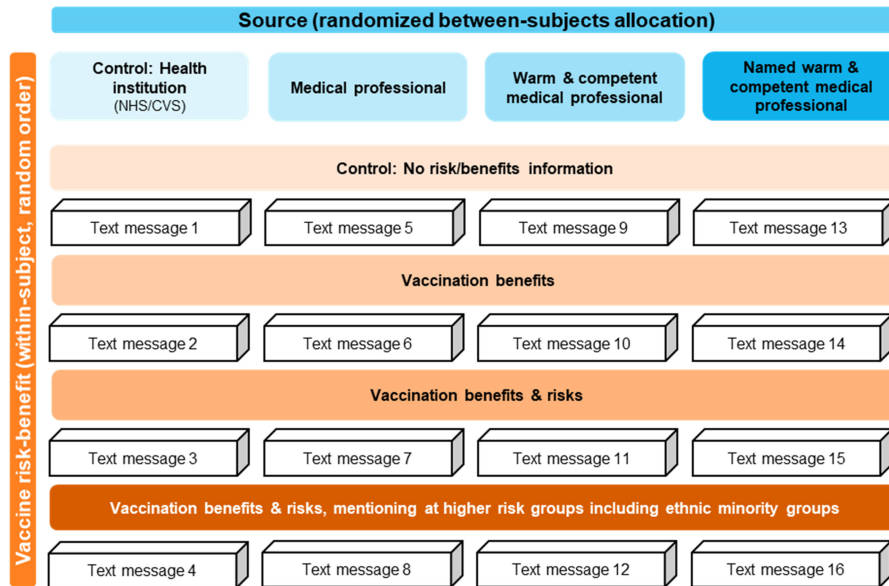We used a 4 (vaccine risk–benefit information) × 4 (source) experimental mixed design shown in Figure 1. Vaccine risk–benefit information was manipulated within-subjects with order randomized for each participant, and source was randomly allocated between-subjects by the Qualtrics built-in randomizer, using the Mersenne Twister algorithm (Matsumoto & Nishimura, 1998).

Participants read and judged four messages, presented in a randomized order to each participant on a separate page. The messages varied regarding risk–benefit information about the COVID booster (see Table 1). The control no risk–benefit condition only included the vaccination appointment, similar to the message the NHS used in the United Kingdom: "You are invited to book your COVID-19 booster vaccination. Click here to book an appointment." We then introduced additional vaccine information incrementally in three vaccine risk–benefit experimental conditions. In the first experimental condition, we shared vaccine benefits only, then vaccine risks and benefits, and finally, vaccine risks and benefits for most vulnerable groups, including ethnic minority groups. The four invitations were sent by one of four randomly allocated sources (see Table 1). The control source was a health institution: the NHS in the U.K. sample and CVS in the United States. In the first source experimental condition, the source was presented as a local medical professional. In the second source experimental condition, participants read, in addition, that the medical professional was "an expert who cared for the community" to better showcase warmth and competence. Finally, in the third source experimental condition, participants read all this information as well as the name of the medical professional. The name suggested that the doctor belonged to the Asian community for the U.K. sample (Sanjay Kumar) and the Black American community in the U.S. sample (Lamar Washington), representing the largest possible ethnic minority group that showed heightened vaccine skepticism within the United Kingdom and the United States (see more information about the name choice in Section C in the online supplemental materials).

Participants assessed each message's trustworthiness and how likely they would be to use the booking link provided on a 5-point scale (for trust: 1, *untrustworthy*; 3, *not sure*; and 5, *trustworthy*; and booking intention: 1, *no, I would not*; 3, *not sure/maybe later*; and 5, *yes, I would*). The midpoint of the trust scale reflects a situation where the person cannot express a clear preference for trust or distrust, which we characterize by a state of uncertainty regarding the trustworthiness of the message. Similarly, for the booking intention scale, the midpoint label we chose reflected this uncertainty while also allowing participants to delay their decision (not sure/maybe later), a preference typical of moderate level of hesitancy (MacDonald, 2015). See full materials in Section C in the online supplemental materials.

Figure 1

Experimental Design Showing the 16 Vaccination Invitation Text Messages That Resulted From the Crossing of Two Independent Variables: Vaccine Risk–Benefit Information (Vertical Axis) and Source (Horizontal Axis), With Four Conditions Each (One Control + Three Experimental Conditions)

Note. NHS = National Health Service; CVS = CVS Pharmacy. See the online article for the color version of this figure.

Statistical Analyses

To test the effect of our vaccination invitation messages, we conducted a mixed design multivariate analysis of variance, with as independent variables four levels of risk–benefit vaccine information in within-subject and four sources in between-subjects, along with ethnicity (minority groups vs. majority) and country as between-subjects factors and trust and booking intention as dependent variables. A *p* value threshold of .05 was chosen a priori to determine statistical significance in our study. The analyses were conducted with IBM SPSS 27 and visualization with the Seaborn package (Version: 0.11.2) in Python 3.6.6. The data and code to replicate the analyses are available in the Open Science Framework: https://osf.io/8waer/.

Table 1

Examples of Materials Showing the Manipulation of Risk–Benefit Information and Information Source Used to Increase Trust and Vaccination Intention

Risk–benefit information manipulation (with control institution source)	Source manipulation (with control no risk–benefit information)
You are invited to book your COVID-19 booster vaccination.	As your local GP [and a health expert who cares for the local community], I would like to invite you to book your COVID-19 booster vaccination. Click here to book an appointment: https://accurx.thirdparty.nhs.uk/r/aafwaczmd5 *Dr. Sanjay Kumar/Dr. Lamar J. Washington, MD*
The vaccine reduces your chance of becoming infected and protects you against severe forms of the illness. It also protects your loved ones by reducing the risk that you infect others. COVID can be severe, do not risk it.	
This vaccination is especially important for people who are at higher risk from COVID such as older individuals or those from ethnic minorities.	
[Vaccines may cause side effects, but the benefits outweigh the risks. The most common side effects are very mild (e.g., sore arm, a fever) and severe side effects are very rare (e.g., allergic reaction).]	
Click here to book an appointment: https://accurx.thirdparty.nhs.uk/r/aafwaczmd5	

Note. The control no risk–benefit information and control source message was "You are invited to book your COVID-19 booster vaccination. Click here to book an appointment: https://accurx.thirdparty.nhs.uk/r/aafwaczmd5" based on the NHS vaccination invitation message. The text shown here show the message in the third experimental condition of the risk–benefit and source manipulation. That condition included the control message (shown here without particular font), the text added in the first experimental condition (underlined), the text added for the second experimental condition (between square brackets), and the text added in the third experimental condition (between asterisks). COVID-19 = coronavirus disease; GP = general practitioner; NHS = National Health Service.

Results

Gap in Vaccination Rates and Trust Between Ethnic Minority Groups and the Majority

Participants from ethnic minority groups were seven percentage points less likely to have received the COVID first vaccination, 76% versus 83%, $\chi^2(1, N = 4,007) = 28.93$, $p < .001$, $\varphi = -.09$. The gap widens when considering the booster. Within those who had received their first COVID vaccination (and were eligible for the booster), people from ethnic minority groups were 13 percentage points less likely to have received the booster dose or to have firm plans to do it within a week, 60% versus 73%, $\chi^2(2, N = 4,018) = 79.32$, $p < .001$, $\varphi = -.14$. Details of vaccination rates across countries and groups are shown in Table SM7 in the online supplemental materials. Participants from ethnic minority groups also reported statistically significantly less trust in the vaccination invitation message (see Figure 2 and the effect of ethnicity in Table 2).

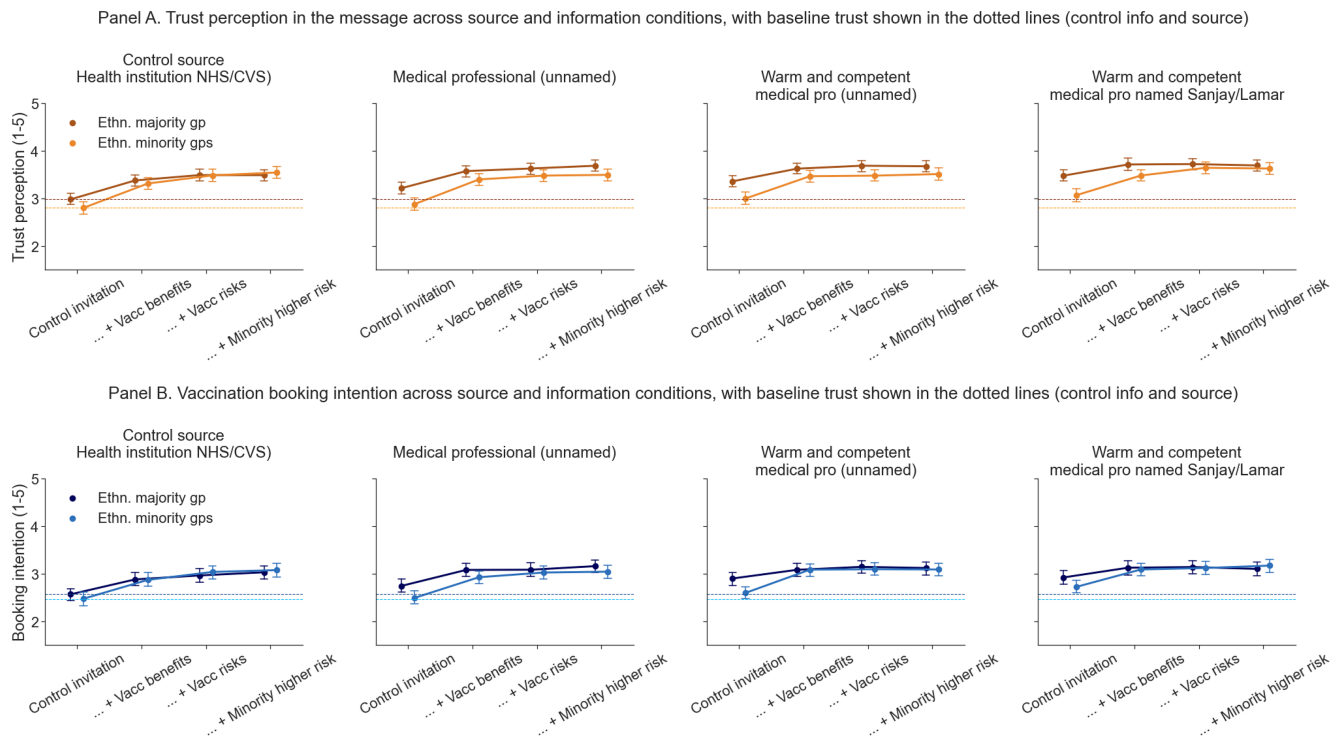### Is Risk–Benefit Information Effective in Increasing Trust?

The vaccine risk–benefit information provided in the message had a positive effect on trust in the message and booking intention, and these effects were larger for people from ethnic minority groups (see main and interaction effects in Table 2). The pairwise comparison analysis (Table 3) showed that relative to the control no risk–benefit information, the messages that included information about the benefits of the COVID vaccine statistically significantly increased trust perception and booking intention. Adding information about the vaccine risks also elevated trust perception and booking intention. Finally, mentioning that ethnic minority groups were "at higher risk" did not further increase trust and booking intention. Importantly, people from ethnic minority groups benefited more from the risk–benefit information.

As shown in Figure 2, the control no risk–benefit condition (shown on the left-hand side of each panel) produced the largest gap between participants from ethnic minority groups and the White majority. The disparity in how much individuals trusted the message reduced with the provision of vaccine information and almost disappeared when the message contained the full information about vaccine benefits and risks. Further analyses indicate that adding risk and benefit information had statistically significant effects in the majority and ethnic minority groups. These effects were larger for people from ethnic minority groups. Furthermore, the positive effect of the risk–benefit manipulation was consistent within each of the different ethnic minority groups in the United Kingdom and the United States (see Section E in the online supplemental materials).

Figure 2

Effect of Vaccine Risk–Benefit Information and Message Source for Ethnic Minority and Majority Groups Showing How the Provision of Information Reduced the Gap in Trust (Panel A) and Booking Intention (Panel B)

Note. Mean response with error bars representing 95% confidence intervals. The dotted horizontal line shows the average baseline response of participants in the control source and control no risk–benefit information condition (left-hand side of leftmost panel) to better showcase the effect of the source across graphs. The line in lighter hue shows the average for people from ethnic minority groups while the darker color shows the average for people from the White majority. Judgments were given on 5-point scales, where for trust: 1, *untrustworthy*; 3, *not sure*; and 5, *trustworthy* and for booking intention: 1, *no, I would not*; 3, *not sure/maybe later*; and 5, *yes, I would*. NHS = National Health Service; CVS = CVS Pharmacy; pro = professional; Ethn. majority gp = ethnic majority group; Ethn. minority gps = ethnic minority groups; Vacc = vaccine. See the online article for the color version of this figure.

Table 2

A Multivariate Analysis of Variance Showed That Risk–Benefit Information About the Vaccine and a Warm and Competent Medical Professional Source Increased Recipients' Trust in the Message and Booking Intention (N = 4,038)

Predictors	Trust in the message				Booking intention			
	df	F	p	η_p^2	df	F	p	η_p^2
Experimental manipulations								
Risk benefit (four levels)	3, 10060	345.78	<.001	.079	3, 10637	273.42	<.001	.064
Source (four levels)	3, 4025	6.96	<.001	.005	3, 4025	3.25	.020	.002
Risk Benefit × Source	8, 10060	4.07	<.001	.003	8, 10637	3.91	<.001	.003
Ethnic minority gps versus maj								
Ethnic group (min vs. maj)	1, 4025	19.50	<.001	.005	1, 4025	2.29	.131	.001
Risk Benefit × Ethnic Minority	3, 10060	17.86	<.001	.004	3, 10637	16.19	<.001	.004
Source × Ethnic Minority	3, 4025	1.13	.336	.001	3, 4025	0.50	.683	<.001
Country of residence								
Country	1, 4025	0.18	.672	<.001	1, 4025	1.98	.160	.001
Risk Benefit × Country	3, 10060	0.44	.686	<.001	3, 10637	0.95	.408	<.001
Source × Country	3, 4025	0.80	.493	.001	3, 4025	1.13	.336	.001
Ethnic Group × Country	1, 4025	0.50	.481	<.001	1, 4025	0.77	.379	<.001

Note. Providing risk–benefit information was particularly helpful in raising trust and booking intention in ethnic minority groups. Results show univariate tests. *df* of the within-subjects effects are rounded values at the unit of Huynh–Feldt adjusted values (e.g., 2.65 became 3). gps = groups; maj = majority group; min = minority groups.

Can a Warm and Competent Medical Professional Increase Trust and Reduce the Trust gap?

The source of the message had a main effect on trust in the message and vaccination booking intention (see Table 2), but not all the changes in the description of the source led to increments in trust and booking intention. The pairwise comparisons in Table 3 show that swapping a health institution source (NHS/CVS) for a medical professional was insufficient to statistically significantly raise trust and booking intention. However, relative to the message sent by a health institution, the message sent by a medical professional described as warm and competent was perceived as more trustworthy (but did not increase booking intention). The same medical professional sharing their name (a typically Indian or Black American name) yielded more trust in the message and booking intention than the message sent by the health institution. In contrast with our expectations, source manipulation was not especially beneficial to people from ethnic minority groups; instead, it benefitted people from ethnic minority groups and the White majority equally (null interaction effect for Source × Ethnicity).

Notably, the effect of the source depended on the content of the message (see the Vaccine Risk–Benefit × Source interaction effect in Table 2). The effect of the source was most important in the control no risk–benefit condition and became more tenuous when the

Table 3

Effect of the Addition of Risk–Benefit Vaccine Information and Description of the Source on Trust Perception in the Message and Vaccination Booking Intention (Pairwise Comparisons With Bonferroni Adjustment)

Pairwise comparisons	Trust		Booking	
	M_{diff}	p	M_{diff}	p
Risk–benefit information				
Control no info versus Benefits	0.40***	<.001	0.34***	<.001
Control no info versus Benefits and risks	0.48***	<.001	0.40***	<.001
Control no info versus Benefits and risks and ethnic min at higher risk	0.49***	<.001	0.42***	<.001
Benefits versus Benefits and risks	0.08***	<.001	0.06***	.001
Benefits and risks versus Benefits and risks and ethnic min at higher risk	0.01	>.999	0.02	.683
Source				
Control (health institution) versus Medical professional	0.11	.271	0.08	>.999
Control (health institution) versus Warm and competent medical pro	0.16*	.016	0.15	.119
Control (health institution) versus Named warm and competent medical pro (Sanjay/Lamar)	0.24***	<.001	0.19*	.022
Medical professional versus Warm and competent medical pro	0.05	>.999	0.07	>.999
Warm and competent medical pro versus Named warm and competent medical pro (Sanjay/Lamar)	0.08	.833	−0.04	>.999

Note. min = minority groups; pro = professional.
* p < .05. *** p < .001.

message became more elaborated. The interaction effect is visible in Figure 2, where the slope showing the effect of information provision is more pronounced in the control source condition (the leftmost panel) and becomes flatter with medical professional sources because the trustworthiness of the source was more influential in raising trust and booking intention in the control–no information condition. The interaction pattern is also more directly visible in Figure SM3 in the online supplemental materials. The effects of the source manipulation and its interaction with the risk–benefit information were further tested within each ethnic minority group separately, showing null results as reported in Section E in the online supplemental materials. We also further tested the effect of using a name suggesting that the doctor belonged to an ethnic minority (Indian in the United Kingdom and Black in the United States) within each ethnic minority group. This manipulation did not especially benefit in-group ethnic group members, as reported in Section G in the online supplemental materials.

Evaluating the Robustness of the Effects

Despite U.S. respondents showing lower trust and booking intention than U.K. respondents, the link between ethnicity and trust perception and booking intention did not vary across countries. The effects of the vaccine risk–benefit information and source were consistent in both countries (the interaction effects between those factors and country of residence were not statistically significant). We also reported above that the effects held within different ethnic groups. We further assess here whether the effects of the risk–benefit vaccine information and its interaction with the source were robust (a) after controlling for key sociodemographic characteristics and (b) after ruling out effects of order by only examining the first message seen by participants.

When we assessed the robustness of the effects while controlling for age, gender, and education in a multivariate analysis of covariance, we replicated our key findings. The positive effects of the risk–benefit information and source (and their interaction) were robust; providing risks and benefits information still benefited people from ethnic minority groups more than the White majority (interaction effect on trust and booking intention). We also found that age, gender, and education played statistically significant roles in trust and booking intention. Younger participants, women, and those with less education trusted the text message less and reported lower booking intention (detailed results in Table SM13 in the online supplemental materials).

Second, the risk–benefit information was manipulated within-subjects (using a randomized presentation order for each participant), so the effect of the manipulation may be at least partly due to participants comparing messages between trials. To evaluate whether the effect of message information would be robust if we withdrew the possibility of comparing the content of the messages, we tested our hypotheses by focusing only on participants' responses to the first message. The analyses, reported in Section I in the online supplemental materials, replicate the effect of risk–benefit vaccine information consistently with our expectations and had a statistically significant effect on both trust in the message and booking intention.

Discussion

Text messages have proved to be an essential digital tool for health campaigns, notably for the COVID-19 vaccine, where they are established as a cost-effective strategy to roll out a vaccination program to an entire population. The challenge now is to optimize these invitation messages to foster trust and increase uptake, particularly where disparities exist, as is the case across ethnic/racial groups in the United Kingdom and the United States. People from ethnic minority groups in these two countries are more vulnerable to COVID (CDC, 2022; ONS, 2021) yet less likely to be vaccinated (Kriss et al., 2022; Nguyen et al., 2022; ONS, 2022). Because this hesitancy is associated with distrust in health institutions and a skewed perception of risks and benefits (Hussain et al., 2022; Nguyen et al., 2022), we proposed to tackle it with a two-pronged approach, changing both the content of the message and its source.

Following the sociocognitive dual-factor model of trust, which states that competence and warmth are central to trust (Fiske & Dupree, 2014), we tailored the content and source of a vaccine invitation text message to maximize trust and vaccination booking intention. We tested and found evidence that vaccine risk–benefit information and a medical professional could increase trust and close the gap between ethnic minority groups and the White majority group in the United Kingdom and the United States. Our findings support the dual-factor model of trust (Fiske & Dupree, 2014) by showing that indicators of competence and warmth did raise trust perception and that competence and warmth can be demonstrated through information shared and the description of the source of information.

Our results show that vaccine invitations providing information about the benefits and risks of the vaccine relative to the risk of contracting COVID raised trust in the message for the overall sample, especially in ethnic minority groups. Risk–benefit information closed the trust gap between the white majority and ethnic minority groups compared to a no-information vaccination invitation. These gains were found in both the United Kingdom and the United States despite the two populations having different rates of vaccination acceptance, ethnic group composition, and healthcare systems.

A comparison of the effect of different pieces of risk–benefit vaccine information showed that sharing only information about the vaccine's benefits was instrumental to increasing trust and vaccination booking intention. This finding is consistent with other reports showing that providing information about vaccine benefits increased vaccination intention (Hallsworth et al., 2021; Palm et al., 2021) but inconsistent with later research conducted in the United Kingdom reporting that describing the benefits of vaccines did not increase vaccination intention (Freeman et al., 2021). The inconsistency could be explained by a ceiling effect in past research due to participants' overly positive responses regarding the first COVID vaccination (e.g., Juanchich et al., 2023). In the present study, we avoided such a ceiling effect as we focused on the COVID booster, which received a more critical response as demonstrated by its lower uptake.

Our results also show that focusing only on the benefits of vaccines would be myopic and detrimental to trust, since disclosing risks and benefits together increases trust relative to conveying benefits alone. Petersen et al. found that disclosing risks benefited trust but decreased vaccination intention (Petersen et al., 2021). We replicated that disclosing risks increases recipients' trust but did not find that it reduced vaccination intention. On the contrary and as expected, our approach to describing risks increased vaccination booking intention. Sharing information about the risks should be done systematically and in a way that is precise enough to correct people's misperceptions and in a way that facilitates the comparison

between the risks of the vaccines and the risks of contracting COVID so that on balance, people are empowered to make the best decision.

In a pilot study, we found that half of the people from ethnic minority groups were not aware that they were at higher risk from COVID, yet providing this information was insufficient to raise the motivation to be vaccinated of those most at risk. The information that ethnic minority groups are one of the groups more at risk from COVID did not increase trust and booking intention in the overall sample nor among ethnic minority groups. This is possibly because participants did not believe that people from ethnic minority groups are more at risk simply based on the text message. British and American public health authorities need to emphasize further the role of ethnicity in COVID risk to health practitioners and the public (currently mostly focusing on age and comorbidities). Health practitioners should, in turn, directly discuss the issue of heightened COVID risk with their patients from ethnic minority groups. It is also worth mentioning that not being at higher risk should not be taken as meaning not being "at any risk" (Holford et al., 2022)—so as not to inadvertently reduce vaccination intention in the White majority. Subsequent research should show how personalizing the risk could help by being more specific (e.g., you are at higher risk based on your age and ethnicity vs. people who are older and belong to this ethnic minority group are more at risk).

Our study also showed the potential of medical professional sources in convincing people from ethnic minority groups and the White majority to trust a message and book their vaccination appointment. In the United Kingdom, the NHS is a well-loved and trusted institution, yet we found that a message sent by a medical professional whose competence and warmth were outlined increased recipients' trust. This same doctor signing their message also increased booking intention. The pattern was the same in the United States, with a control text message from a pharmacy chain. We found that anonymous medical professionals not explicitly identified as caring experts did not elicit greater trust than a health institution. This is possibly because the connection between patients and family physicians has been eroded with the rise of phone call consultations (Ipsos MORI, 2022).

Interestingly, the effect of the source partly depended on the message. Past work showed that the source's credibility shaped the effect of the message (Betsch & Sachse, 2013), albeit in a different direction. Based on this work, we could have expected the medical professional source to magnify the effect of the information given, meaning that the source would matter more when the message included more information. Instead, we found that the source had a smaller effect when the message included more information. People relied more on the characteristics of the source when the invitation message did not include any risk–benefit vaccine information, possibly because the provision of risk–benefit information also indicated the expertise of the sender.

Vaccine text message invitations are critical to the success of modern vaccination campaigns (Phillips et al., 2014). We recommend providing more vaccine facts with the invitation to increase the effectiveness of vaccination campaigns (for COVID or other forms of vaccinations). This implementation would give the occasion to assess whether our results on hypothetical invitations would translate into actual vaccination uptake. The invitation messages should include information about the benefits and risks of the side effects of vaccines. This description should be specific and contrast the risks of COVID with the risks and benefits of the vaccine to facilitate an informed decision, foster trust, and increase booking intention. Furthermore, we recommend that medical professionals be more involved in vaccination invitations, with messages that explicitly assert their warmth and competence, for example, by describing them as medical experts caring for the community. Involving medical professionals is especially important in communications where message length is constrained and information provision impractical or impossible.

These recommendations should prove especially beneficial to people from ethnic minority groups in the United Kingdom and the United States as they are equally—or more—effective in raising their trust perception and vaccination booking intention. Public health decisions require both a macro perspective and a nuanced micro perspective. Here, we adopted a macro perspective to facilitate comparisons to other studies by following agreed standards to address the gap in trust experienced by ethnic minority groups in the United Kingdom and the United States (e.g., generic ethnic categories used by the Office for National Statistics). However, a finer approach is also helpful, for example, one that does not lump different ethnic minority groups together to focus on their specific response to COVID vaccine invitations. In our study, the effect of the vaccination message especially benefited people from ethnic minority groups. The trend was consistently found across broad ethnic minority groups in the United Kingdom and the United States (see Section E in the online supplemental materials). Nonetheless, further research with larger samples of people from specific groups could assess whether the benefits hold across these groups. Indeed, considerable variability exists within global categories, such as Black in the United States or Asian in the United Kingdom (e.g., in the United Kingdom, Bangladeshi showed lower vaccination rates than Chinese participants). Further research could complement our macro focus and explore factors generating variability within groups (e.g., gender, age, place of birth, state/county of residence, but also experience) to identify factors that protect individuals from misinformation and facilitate the uptake of official medical advice (e.g., Knights et al., 2021). Finally, testing the effect of risk–benefit information and the message source on actual vaccination behavior is a key priority for future research. We demonstrated the effects in a hypothetical situation and expected they would translate into an increased booking rate, but this effect remains to be tested in naturalistic settings. A good "test bed" would be to use the COVID booster or another annual vaccination invitation, such as for the flu vaccination. Conducting research on actual health behaviors will help develop more effective invitation messages for annual vaccinations, and future vaccinations should a new epidemic arise. Evidence could also be used to raise the uptake of essential health appointments, such as annual checks and screenings.

Limitations

Our sample was intentionally more ethnically diverse than the population and balanced in gender and age, but it still has some limitations. Primarily, participants self-selected to participate—people who were most or least reluctant to be vaccinated may have been more likely to opt in. Large-scale surveys are subject to bias in the appraisal of vaccination acceptance, tending to overestimate it (Bradley et al., 2021). However, our goal here was not to accurately estimate the population's vaccination intention but to examine cross-group differences as a function of experimental

manipulations. We sampled a sufficient proportion of people from ethnic minority groups who are typically insufficiently represented in vaccination research, even in large "representative surveys" (Bradley et al., 2021).

Another caveat is that we present data from a single point in time, but we know inequalities fluctuate over time. The gap in vaccination rates between ethnic groups changed over time at a rate that might vary across countries. While at the onset of the mass vaccination campaign in 2021, the United States exhibited a larger ethnic gap than the United Kingdom (Nguyen et al., 2022), 1 year later, when we collected our data (February 2022), we observed the opposite: larger ethnic disparities in the United Kingdom than in the United States (−11 percentage points in the United Kingdom and −2 in the United States). Our observations are consistent with research showing that vaccine hesitancy evolves differently across ethnic groups (Kriss et al., 2022): Hesitancy dropped faster in Black Americans than it did for White Americans. Notably, the same ethnic disparities that occurred for the first round of COVID vaccines, which narrowed and sometimes disappeared over time (Kriss et al., 2022), still reappeared for the COVID booster vaccines. Consistently, we found ethnic disparities were close to twice larger for the booster than for the first COVID vaccine (−7 vs. −13 percentage points). Even if the differences slim down over time, people from ethnic minorities are consistently disadvantaged and at greater risk of severe illness and death for viral illnesses requiring annual vaccinations, such as COVID, which underscores the importance of building trustworthy health communications.

Conclusion

Vaccination invitation messages can be tailored to raise recipients' trust and booking intention and reduce the trust gap in vaccination between ethnic minority groups and the White majority. Our work demonstrates the positive impact of outlining the benefits and disclosing the risks of COVID vaccines in vaccination invitation messages. Having a caring, competent medical professional as the source also fosters trust where the message is limited in scope.

Resumen

Objetivo: Nuestro objetivo es identificar invitaciones de vacunación que fomenten la confianza y mejoren la aceptación de la vacunación en general, especialmente entre los grupos étnicos minoritarios que corren mayor riesgo de contraer COVID y tienen menos probabilidades de vacunarse. *Métodos:* En un experimento de diseño mixto 4 × 4 pre registrado, manipulamos cuánta información riesgo-beneficio incluida el mensaje dentro de los sujetos y la fuente del mensaje entre sujetos ($N = 4,038$ participantes del Reino Unido y EE. UU., 50 % de minoría étnica). Los participantes leyeron cuatro invitaciones a vacunas que variaban en la información riesgo-beneficio de la vacunación (orden aleatorio): Control (sin información), Solo beneficios, Riesgo y beneficio, y Riesgo y beneficio que menciona a grupos vulnerables. Los mensajes fueron enviados por una de cuatro fuentes (asignación aleatoria): Control (institución de salud: NHS/CVS), Profesional médico (no nombrado), Profesional médico cálido y competente (no nombrado) y Profesional médico cálido y competente designado (Sanjay/Lamar). Los participantes evaluaron cuánto confiaban en el mensaje y qué probabilidades tendrían de programar su cita de vacunación. *Resultados:* La información sobre los beneficios y riesgos de la vacunación aumentó la confianza, especialmente entre los grupos étnicos minoritarios, para quienes el efecto se replicó dentro de cada grupo. La confianza también aumentó cuando el mensaje fue enviado por un profesional médico cálido y competente en relación con una institución de salud, pero la importancia de la fuente importó menos cuando se compartió más información. *Conclusiones:* Nuestra investigación demuestra el impacto positivo de describir los beneficios y revelar los riesgos de las vacunas COVID en los mensajes de invitación a la vacunación. Tener una fuente profesional médica cálida y competente también puede aumentar la confianza, especialmente cuando el mensaje tiene un rango limitado.

References

Allington, D., McAndrew, S., Moxham-Hall, V., & Duffy, B. (2023). Coronavirus conspiracy suspicions, general vaccine attitudes, trust and coronavirus information source as predictors of vaccine hesitancy among UK residents during the COVID-19 pandemic. *Psychological Medicine*, *53*(1), 236–247. https://doi.org/10.1017/S0033291721001434

Aw, J., Seng, J. J. B., Seah, S. S. Y., & Low, L. L. (2021). COVID-19 vaccine hesitancy—A scoping review of literature in high-income countries. *Vaccines*, *9*(8), Article 900. https://doi.org/10.3390/vaccines9080900

Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: A meta-analysis. *Psychological Bulletin*, *140*(6), 1556–1581. https://doi.org/10.1037/a0037737

Betsch, C., & Sachse, K. (2013). Debunking vaccination myths: Strong risk negations can increase perceived vaccination risks. *Health Psychology*, *32*(2), 146–155. https://doi.org/10.1037/a0027387

Bradley, V. C., Kuriwaki, S., Isakov, M., Sejdinovic, D., Meng, X.-L., & Flaxman, S. (2021). Unrepresentative big surveys significantly overestimated US vaccine uptake. *Nature*, *600*(7890), 695–700. https://doi.org/10.1038/s41586-021-04198-4

Callaghan, T., Moghtaderi, A., Lueck, J. A., Hotez, P., Strych, U., Dor, A., & Motta, M. (2021). Correlates and disparities of intention to vaccinate against COVID-19. *Social Science & Medicine (1982)*, *272*, Article 113638. https://doi.org/10.1016/j.socscimed.2020.11363

CDC. (2022). *Risk for COVID-19 infection, hospitalization, and death by race/ethnicity.* https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html

Charness, G., & Gneezy, U. (2008). What's in a name? Anonymity and social distance in dictator and ultimatum games. *Journal of Economic Behavior & Organization*, *68*(1), 29–35. https://doi.org/10.1016/j.jebo.2008.03.001

Charura, D., Hill, A. P., & Etherson, M. E. (2022). COVID-19 vaccine hesitancy, medical mistrust, and mattering in ethnically diverse communities. *Journal of Racial and Ethnic Health Disparities*, *10*(3), 1518–1525. https://doi.org/10.1007/s40615-022-01337-z

Chen, N. T. (2015). Predicting vaccination intention and benefit and risk perceptions: The incorporation of affect, trust, and television influence in a dual-mode model. *Risk Analysis*, *35*(7), 1268–1280. https://doi.org/10.1111/risa.12348

Coulter, A., Entwistle, V., & Gilbert, D. (1999). Sharing decisions with patients: Is the information good enough? *BMJ*, *318*(7179), 318–322. https://doi.org/10.1136/bmj.318.7179.318

Cuddy, A. J. C., Fiske, S. T., & Glick, P. (2008). Warmth and competence as universal dimensions of social perception: The stereotype content model and the BIAS map. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 40, pp. 61–149). Elsevier Academic Press. https://doi.org/10.1016/S0065-2601(07)00002-0

Fiske, S. T., & Dupree, C. (2014). Gaining trust as well as respect in communicating to motivated audiences about science topics. *Proceedings of the*

National Academy of Sciences, 111(Supplement_4), 13593–13597. https://doi.org/10.1073/pnas.1317505111

Freeman, D., Loe, B. S., Yu, L. M., Freeman, J., Chadwick, A., Vaccari, C., Shanyinde, M., Harris, V., Waite, F., Rosebrock, L., Petit, A., Vanderslott, S., Lewandowsky, S., Larkin, M., Innocenti, S., Pollard, A. J., McShane, H., & Lambe, S. (2021). Effects of different types of written vaccination information on COVID-19 vaccine hesitancy in the UK (OCEANS-III): A single-blind, parallel-group, randomised controlled trial. *The Lancet Public Health, 6*(6), e416–e427. https://doi.org/10.1016/S2468-2667(21)00096-7

Gaughan, C. H., Razieh, C., Khunti, K., Banerjee, A., Chudasama, Y. V., Davies, M. J., Dolby, T., Gillies, C. L., Lawson, C., Mirkes, E. M., Morgan, J., Tingay, K., Zaccardi, F., Yates, T., & Nafilyan, V. (2022). Corrigendum to: COVID-19 vaccination uptake amongst ethnic minority communities in England: A linked study exploring the drivers of differential vaccination rates. *Journal of Public Health, 44*(4), Article 936. https://doi.org/10.1093/pubmed/fdac021

GOV.UK. (2021). *Booking your coronavirus (COVID-19) vaccination appointments*. https://assets.publishing.service.gov.uk/media/628518878fa8f5561960ef03/COVID-19_vaccination_Invitation_letter_English.pdf

Hallsworth, M., Mirpuri, S., & Toth, C. (2021). *Four messages that can increase uptake of the COVID-19 vaccines. Using large-scale testing to identify effective vaccine messaging*. https://www.bi.team/blogs/four-messages-that-can-increase-uptake-of-the-covid-19-vaccines

Holford, D. L., Juanchich, M., & Sirota, M. (2022). Ambiguity and unintended inferences about risk messages for COVID-19. *Journal of Experimental Psychology: Applied, 28*(3), 486–508. https://doi.org/10.1037/xap0000416

Hussain, B., Latif, A., Timmons, S., Nkhoma, K., & Nellums, L. B. (2022). Overcoming COVID-19 vaccine hesitancy among ethnic minorities: A systematic review of UK studies. *Vaccine, 40*(25), 3413–3432. https://doi.org/10.1016/j.vaccine.2022.04.030

Ipsos MORI. (2022). *GP patient survey National report 2022 survey*. https://www.gp-patient.co.uk/surveysandreports

Jennings, W., Stoker, G., Bunting, H., Valgarðsson, V. O., Gaskell, J., Devine, D., McKay, L., & Mills, M. C. (2021). Lack of trust, conspiracy beliefs, and social media use predict COVID-19 vaccine hesitancy. *Vaccines, 9*(6), Article 593. https://doi.org/10.3390/vaccines9060593

Juanchich, M. (2023). *Open Science Framework page for fostering trust in vaccination invitations—Preregistration, materials, data*. https://doi.org/10.17605/OSF.IO/8WAER

Juanchich, M., Sirota, M., & Holford, D. L. (2023). How should doctors frame the risk of a vaccine's adverse side effects? It depends on how trustworthy you are. *Medical Decision Making, 43*(7–8), 835–849. https://doi.org/10.1177/0272989X231197646

Kamal, A., Hodson, A., & Pearce, J. M. (2021). A rapid systematic review of factors influencing COVID-19 vaccination uptake in minority ethnic groups in the UK. *Vaccines, 9*(10), Article 1121. https://doi.org/10.3390/vaccines9101121

Katzman, J. G., & Katzman, J. W. (2021). Primary care clinicians as COVID-19 vaccine ambassadors. *Journal of Primary Care & Community Health, 12*, Article 215013272110070. https://doi.org/10.1177/21501327211007026

Knights, F., Carter, J., Deal, A., Crawshaw, A. F., Hayward, S. E., Jones, L., & Hargreaves, S. (2021). Impact of COVID-19 on migrants' access to primary care and implications for vaccine roll-out: A national qualitative study. *British Journal of General Practice, 71*(709), e583–e595. https://doi.org/10.3399/BJGP.2021.0028

Kogut, T., & Ritov, I. (2005). The "identified victim" effect: An identified group, or just a single individual? *Journal of Behavioral Decision Making, 18*(3), 157–167. https://doi.org/10.1002/bdm.492

Kriss, J. L., Hung, M.-C., Srivastav, A., Black, C. L., Lindley, M. C., Lee, J. T., Koppaka, R., Tsai, Y., Lu, P. J., Yankey, D., Elam-Evans, L. D., & Singleton, J. A. (2022). COVID-19 vaccination coverage, by race and ethnicity—National immunization survey adult COVID module, United States, December 2020-November 2021. *MMWR. Morbidity and Mortality Weekly Report, 71*(23), 757–763. https://doi.org/10.15585/mmwr.mm7123a2

Lencucha, R., & Bandara, S. (2021). Trust, risk, and the challenge of information sharing during a health emergency. *Globalization and Health, 17*(1), Article 21. https://doi.org/10.1186/s12992-021-00673-9

MacDonald, N. E., & the SAGE Working Group on Vaccine Hesitancy. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161–4164. https://doi.org/10.1016/j.vaccine.2015.04.036

Matsumoto, M., & Nishimura, T. (1998). Mersenne twister: A 623-dimensionally equidistributed uniform pseudo-random number generator [TOMACS]. *ACM Transactions on Modeling and Computer Simulation, 8*(1), 3–30. https://doi.org/10.1145/272991.272995

Milkman, K. L., Patel, M. S., Gandhi, L., Graci, H. N., Gromet, D. M., Ho, H., Kay, J. S., Lee, T. W., Akinola, M., Beshears, J., Bogard, J. E., Buttenheim, A., Chabris, C. F., Chapman, G. B., Choi, J. J., Dai, H., Fox, C. R., Goren, A., Hilchey, M. D., & Duckworth, A. L. (2021). A megastudy of text-based nudges encouraging patients to get vaccinated at an upcoming doctor's appointment. *Proceedings of the National Academy of Sciences, 118*(20), Article e2101165118. https://doi.org/10.1073/pnas.2101165118

Nguyen, L. H., Joshi, A. D., Drew, D. A., Merino, J., Ma, W., Lo, C.-H., Kwon, S., Wang, K., Graham, M. S., Polidori, L., Menni, C., Sudre, C. H., Anyane-Yeboa, A., Astley, C. M., Warner, E. T., Hu, C. Y., Selvachandran, S., Davies, R., Nash, D., … Chan, A. T., & the COPE Consortium. (2022). Self-reported COVID-19 vaccine hesitancy and uptake among participants from different racial and ethnic groups in the United States and United Kingdom. *Nature Communications, 13*(1), Article 636. https://doi.org/10.1038/s41467-022-28200-3

ONS. (2021). *Updating ethnic contrasts in deaths involving the coronavirus (COVID-19), England: 24 January 2020 to 31 March 2021*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/updatingethniccontrastsindeathsinvolvingthecoronaviruscovid19englandandwales/24january2020to31march2021

ONS. (2022). *Coronavirus (COVID-19) latest insights: Vaccines*. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19latestinsights/vaccines

Our World in Data. (2024). *Coronavirus (COVID-19) vaccinations*. https://ourworldindata.org/covid-vaccinations

Padamsee, T. J., Bond, R. M., Dixon, G. N., Hovick, S. R., Na, K., Nisbet, E. C., Wegener, D. T., & Garrett, R. K. (2022). Changes in COVID-19 vaccine hesitancy among black and white individuals in the US. *JAMA Network Open, 5*(1), Article e2144470. https://doi.org/10.1001/jamanetworkopen.2021.44470

Palm, R., Bolsen, T., & Kingsland, J. T. (2021). The effect of frames on COVID-19 vaccine resistance. *Frontiers in Political Science, 3*(41), Article 661257. https://doi.org/10.3389/fpos.2021.661257

Petersen, M. B., Bor, A., Jørgensen, F., & Lindholt, M. F. (2021). Transparent communication about negative features of COVID-19 vaccines decreases acceptance but increases trust. *Proceedings of the National Academy of Sciences, 118*(29), Article e2024597118. https://doi.org/10.1073/pnas.2024597118

Phillips, A. L., Kumar, D., Patel, S., & Arya, M. (2014). Using text messages to improve patient-doctor communication among racial and ethnic minority adults: An innovative solution to increase influenza vaccinations. *Preventive Medicine, 69*, 117–119. https://doi.org/10.1016/j.ypmed.2014.09.009

Tajfel, H. (1982). Social psychology of intergroup relations. *Annual Review of Psychology, 33*(1), 1–39. https://doi.org/10.1146/annurev.ps.33.020182.000245

Thorpe, A., Fagerlin, A., Drews, F. A., Butler, J., Stevens, V., Riddoch, M. S., & Scherer, L. D. (2022). Communications to promote interest and confidence in COVID-19 vaccines. *American Journal of Health Promotion, 36*(6), 976–986. https://doi.org/10.1177/08901171221082904

Thorpe, A., Sirota, M., Juanchich, M., & Orbell, S. (2020). "Always take your doctor's advice": Does trust moderate the effect of information on inappropriate antibiotic prescribing expectations? *British Journal of Health Psychology, 25*(2), 358–376. https://doi.org/10.1111/bjhp.12411

WHO. (2008). *International health regulations*. World Health Organization. https://www.who.int/publications/i/item/9789241580410

WHO. (2022). *COVID-19 advice for the public: Getting vaccinated*. Retrieved October 17, 2023, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice

Williamson, E., Walker, A. J., Bhaskaran, K. J., Bacon, S., Bates, C., Morton, C. E., & Goldacre, B. (2020). OpenSAFELY: Factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients. *Nature*, *584*(7821), 430–436. https://doi.org/10.1038/s41586-020-2521-4