BMJ Global Health

Addressing vaccine hesitancy: experimental evidence from nine high-income countries during the COVID-19 pandemic

Vincenzo Galasso ,[1] Vincent Pons,[2] Paola Profeta,[1] Martin McKee ,[3] David Stuckler,[1] Michael Becher,[4] Sylvain Brouard,[5] Martial Foucault[5]

To cite: Galasso V, Pons V, Profeta P, *et al*. Addressing vaccine hesitancy: experimental evidence from nine high-income countries during the COVID-19 pandemic. *BMJ Glob Health* 2023;**8**:e012658. doi:10.1136/bmjgh-2023-012658

Handling editor Seye Abimbola

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjgh-2023-012658).

VG, VP and PP contributed equally.

Received 24 April 2023
Accepted 4 September 2023

[1]Department of Social and Political Sciences, Bocconi University, Milano, Italy
[2]Harvard Business School, Boston, Massachusetts, USA
[3]London School of Hygiene & Tropical Medicine, London, UK
[4]School of Politics, Economics, and Global Affairs, IE University, Madrid, Spain
[5]Centre de recherches politiques (CEVIPOF), Sciences Po, Paris, France

Correspondence to
Dr Vincenzo Galasso;
vincenzo.galasso@unibocconi.it

ABSTRACT

We study the impact of public health messages on intentions to vaccinate and vaccination uptakes, especially among hesitant groups. We performed an experiment comparing the effects of egoistic and altruistic messages on COVID-19 vaccine intentions and behaviour. We administered different messages at random in a survey of 6379 adults in December 2020, following up with participants in the nationally representative survey Citizens' Attitudes Under COVID-19 Project covering nine high-income countries (Australia, Austria, France, Germany, Italy, New Zealand, Sweden, the UK and the USA). Four alternative interventions were tested, based on narratives of (1) self-protection, (2) protecting others, (3) reducing health risks and (4) economic protection. We measure vaccination intentions in the December 2020 survey and elicit actual vaccination behaviour by respondents in the June/July 2021 survey. Messages conveying self-protection had no effect on vaccine intentions but altruistic messages, emphasising protecting other individuals (0.022, 95% CI −0.004 to 0.048), population health (0.030, 95% CI 0.003 to 0.056) and the economy (0.038, 95% CI 0.013 to 0.064) had substantially stronger effects. These effects were stronger in countries experiencing high COVID-19 mortality (Austria, France, Italy, Sweden, the UK and the USA), where health risks may have been more salient, but weaker and, in several cases, not significant where mortality was low (Australia, Germany and New Zealand). On follow-up at 6 months, these brief communication interventions corresponded to substantially higher vaccination uptake. Our experiments found that commonly employed narratives around self-protection had no effect. However, altruistic messages about protecting individuals, population health and the economy had substantially positive and enduring effects on increasing vaccination intentions. Our results can help structure communication campaigns during pandemics and are likely to generalise to other vaccine-preventable epidemics.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ We performed a systematic search using PubMed on 30 March 2023 using the search terms: COVID, vaccine hesitancy and experiment.
⇒ It produced 90 results.
⇒ Almost all of them were survey experiments using vaccination intentions, rather than actual vaccination, as outcome measure.
⇒ Moreover, only three studies use a multicountry approach (with more than two countries).
⇒ These yielded little insight into how to respond to vaccine hesitancy and effectively increase uptake, especially since vaccination intention may differ from actual vaccination behaviour.

WHAT THIS STUDY ADDS

⇒ Our repeated survey data cover a representative sample of the adult population in nine high-income countries (n=6379).
⇒ Unlike most studies, our survey data elicit vaccine intention and actual vaccination behaviour by respondents.
⇒ Our findings show that altruistic messages about vaccination can substantially increase vaccination intentions and, ultimately, uptake.
⇒ They also point to how different framings can address some of the socioeconomic and attitudinal influences on vaccination intentions.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Public health campaigns using altruistic messages about the role of vaccination appear to be more effective at increasing both vaccine intention and vaccination uptake than conventional messaging focusing on the individual concerned.
⇒ These effects are particularly large in countries where mortality rates from COVID-19 are high.

INTRODUCTION

Despite COVID-19 vaccination rates exceeding 75% in most advanced industrialised nations today, a significant proportion of the population long remained hesitant to get vaccinated, and many have still not done so.[1] As of March 2023, 30% of Americans had yet to complete

a primary course, with the corresponding figures 23% in Germany and 21% in France.[2] People's willingness to get vaccinated affected the severity of the COVID-19 crisis and will determine the effectiveness of our response to future pandemics.

There are many explanations for vaccine hesitancy. A recent systematic review identified seven broad issues: demographic factors influencing vaccination (ethnicity, age, sex, pregnancy, education and employment); accessibility and cost; personal responsibility and risk perceptions; precautionary measures taken based on the decision to vaccinate; trust in health authorities and vaccines; the safety and efficacy of a new vaccine; and lack of information or vaccine misinformation.[3] Another recent systematic review examined possible countermeasures, concluding that multicomponent and dialogue-based interventions are most effective but also noting that the complexity of vaccine hesitancy and the limited evidence available on how it can be addressed calls for strategies to be tailored according to the target population, their reasons for hesitancy and the specific context.[4] A recent phenomenon has been the rise of disinformation campaigns on social media.[5–9] The challenge facing public health bodies is how to convince those who are uncertain and those who are certain but wrong. A substantial body of evidence shows that simply trying to correct false beliefs is, at best, ineffective and, at worst, counterproductive.[10]

This has led to a growing number of studies examining interventions to influence behaviour. However, most have used vaccine intention as the outcome, even though it may not translate into actual decisions.

Here we implement a novel approach, drawing on behavioural economic insights that suggest that altruistic messaging can have a potent effect on changing behaviours in domains such as use of tobacco and other harmful products.[11]

We varied the wording of messages in two waves of surveys in nine Organisation for Economic Co-operation and Development countries at random, with data gathered in December 2020, at the onset of the vaccination campaign in these countries, and in June/July 2021, at its peak. The alternative wordings were standard WHO messaging and altruistic messaging designed following behavioural economic insights.

The use of altruistic messages in promoting vaccine uptake is relatively recent. Most research has focused on so-called loss-gain messaging, comparing messages that emphasise either the risks or the benefits for oneself. In contrast, altruistic messages emphasise the benefits to others. Such messages build on experimental research showing that those who are 'prosocial' and incorporate the interests of others in their decisions are more likely to decide to be vaccinated.[12] A recent study randomly assigned university students to one of three messages, appealing to altruism or to selfishness (either mortality risk or inconvenience).[13] All increased intention to be vaccinated against COVID-19 but the effect of the altruistic message was more than double the others. A more recent study also found that altruistic messaging (in this case referring to the protection of those unable to get vaccinated, such as the immunocompromised) increased vaccine intention, and especially among those who at some point had themselves been vulnerable.[14] A Canadian study also found that exposure to a video promoting altruism increased intention to be vaccinated against COVID-19.[15]

This study adds to that literature in two ways. First, it includes multiple countries that experienced different levels of COVID-19 mortality, and thus perceived risk. Second, by employing a longitudinal design, we were able to link our treatments to reported vaccine uptake and not just intention.

METHODS

Study sample

We use the panel component of two waves of a nationally representative survey of the adult population conducted in nine countries (Australia, Austria, France, Germany, Italy, New Zealand, Sweden, the UK and the USA) and covering 6379 respondents. These data are part of the Citizens' Attitudes Under COVID-19 Project (CAUCP).[16 17] The CAUCP panel data were collected by established commercial polling companies (CSA Research in Australia and the USA, and IPSOS in all other countries), using the computer-assisted web interview method, in five waves, from the outset of the pandemic (wave 1 in late March 2020), throughout 2020 (wave 2 in April 2020, wave 3 in June 2020, wave 4 in December 2020) and 2021 (wave 5 in June/July 2021). The questionnaires of CAUCP surveys followed existing comparative public opinion studies, but more specific questions were asked to address the consequences of the COVID-19 crisis. In each country, participants were recruited online and selected with quota sampling based on gender, age, occupation, region of residence, ethnicity (in the USA) and education (in France). The survey companies provided weights that can be applied to ensure that the sociodemographic characteristics of the sample match the characteristics of the population. Our results are based on the raw data, but they are virtually unchanged when using weights. Data collection and analysis were performed blind to the conditions of the experiments.

Questions on vaccination intentions were introduced in the December 2020 wave, while questions on actual vaccination behaviour were included in the June/July 2021 wave. On average, respondents took around 20 min to answer the questionnaire in these two waves, which we henceforth refer to as first and second. The survey was designed as a rotating panel.[16] Our sample includes a total of 6379 respondents who were successfully surveyed in both waves, corresponding to 59% of the participants in the December 2020 wave (see online supplemental table S1). The demographic characteristics of respondents from the first wave who dropped out of the panel and of

those who remained in it and answered the second wave differ along a few dimensions. Online supplemental table S2 reports the results of regressing a dummy variable for remaining in the study on demographic characteristics (column 1) and on demographic characteristics and the vaccination intentions elicited in the first wave (column 2). In each wave, additional respondents were selected to rebalance the sample and to make it representative at the national level in each country. No statistical methods were used to predetermine sample sizes: our sample sizes correspond to the survey data collected in CAUCP. All the countries included in the survey are high income, allowing us to pool their data in a common analysis while using country fixed effects. However, the pandemic affected the countries very differently. Mortality rates and economic losses, as well as lockdown measures and timing of the vaccination campaigns, largely varied across countries (see online supplemental table S3).

The December 2020 wave of the survey was administered between 2 and 11 December 2020 (see online supplemental table S1 for the exact dates by country), when most countries were experiencing the second wave of the pandemic with new lockdown measures and vaccines had just been authorised. The June/July 2021 wave of the survey was administered between 28 June and 13 July 2021, when vaccination rates in the countries in our sample ranged from 14.1% in New Zealand to 65.8% in the UK. Both survey waves recorded individuals' attitudes, personal experiences and behaviour towards COVID-19, as well as sociodemographic characteristics. Summary statistics for all the variables used in this study, normalised on a 0–1 range for the regression analysis, are shown in online supplemental table S4.

Informational content of the experimental public health messages

We use an experiment to assess the impact of different types of information on vaccination behaviour. In our December 2020 wave, we randomly assigned respondents in each country to one of four messages or a control group receiving no additional message. Following the WHO's risk communication strategies,[18] individuals in all treatment groups (but not controls) were first exposed to the following message, emphasising the importance of vaccines to achieve immunity[19]: 'The only way to become immune to COVID-19 in the long run is by vaccination.'

After this initial statement, treatment respondents were randomly exposed to one of four messages, each emphasising a specific benefit of vaccination. The first message continued the WHO campaign script emphasising self-protection:

1. Self-protection: 'If you were vaccinated, you could avoid getting infected with the virus.'

We compared this message to three variants of altruism focusing on protecting others, the population's health and the economy:

2. Altruism towards others: 'If you were vaccinated, you might be able to avoid passing the virus on to others.'
3. Altruism towards the population: 'If a person was vaccinated, they could avoid getting infected with the virus. This would protect the health of people in your country [in each country, respondents saw the actual name of the country].'
4. Altruism towards the economy: 'If a person was vaccinated, they could avoid getting infected with the virus. It would allow a return to normal economic activity and reduce unemployment.'

Hence, the first treatment appealed to self-interest, while the three others sought to trigger an altruistic response by emphasising different types of benefits for others.[13 14 20 21]

In the December 2020 wave, vaccine hesitancy was assessed by asking respondents, 'If a vaccine against COVID-19 was available in the next few months, would you agree to be vaccinated?', with possible answers ranging from 0 (not at all likely) to 10 (extremely likely). To measure actual vaccination, in the June/July 2021 wave, the same individuals were asked whether they had received at least one dose of any COVID-19 vaccine.

Our statistical analysis evaluated the effect of the experiment based on the following model:

$$Vaccination\ Behavior_{ic} = \alpha + \mu Message_{ic} + \beta F_c + \varepsilon_{ic} \quad (1)$$

Here, i is the individual and c the country. Message is a dummy variable for exposure to one of the four messages, measuring the difference with the control group, which did not receive any message. F_c are country fixed effects and ε_{ic} is the error term. SEs are clustered at the region-country level to adjust for regional correlations. Online supplemental table S5 reports the balance (two-sided) tests for the personal characteristics of the survey participants across the four experimental treatments to confirm that our randomisation into the five groups (one control and four treatments) is balanced on observable characteristics. Our statistical analysis evaluating the effects of the experimental messages was also performed on the two subgroups of low and high-mortality countries.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, nor writing of the paper.

Patient and public involvement

Clinical patients were not involved in this study. The results will not be disseminated to study participants, since the survey was anonymous and participants cannot be identified.

RESULTS

Experimental evidence

Figure 1 (left panel) and online supplemental table S6 (column 1) report the estimated effects of the four interventions on vaccination intentions among those who participated in both waves. We compared these effects with those calculated using all participants in the first

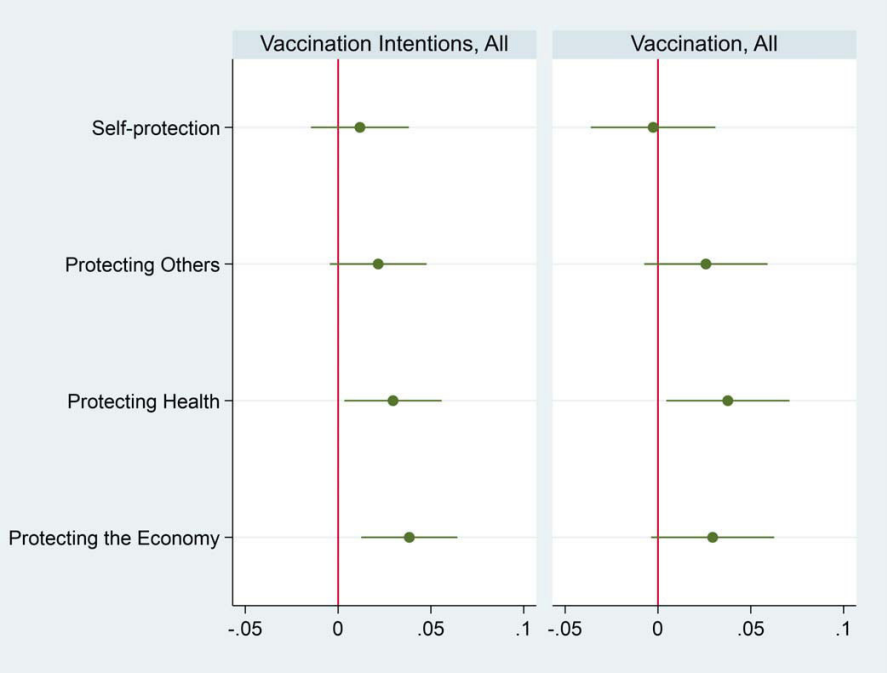


Figure 1 Effects of alternative informational interventions on vaccination intentions and vaccination uptake. Point estimates and 95% CIs for each of the four treatments (self-protection, protecting others, protecting health and protecting the economy), from regressions using pooled data (6379 observations) and the outcome variables 'Vaccination Intentions' (left panel) and 'Vaccination' (right panel) and also controlling for country fixed effects.

wave (online supplemental table S7) and found no material difference, except for a slightly larger effect of the self-protection message when using all participants in the first wave. The WHO self-protection message had no significant effect (1.2, 95% CI −0.015 to 0.038). However, the messages on protecting others, protecting health and protecting the economy were effective, increasing the intention of getting vaccinated by 2.2 percentage points (ppts) (95% CI −0.004 to 0.048), 3.0 ppts (95% CI 0.003 to 0.056) and 3.8 ppts (95% CI 0.013 to 0.064), respectively. These effects correspond to, respectively, an increase of 3.5%, 4.8% and 6.1% compared with the mean in the control group.

The two-sided tests reported in online supplemental table S6 (column 1) show that we can reject the null hypotheses that the treatments have a null effect (joint orthogonality test, p value: 0.024).

Durability of intervention effects

Exposure to altruistic messages corresponded to a higher probability of the recipients reporting having been vaccinated 6 months later. The effects on vaccination rates are increases of 2.6 ppts for protecting others (95% CI −0.007, 0.058), 3.8 ppts for protecting health (95% CI 0.004, 0.071) and 2.9 ppts for protecting the economy (95% CI −0.004, 0.063), corresponding to increases relative to the mean in the control group of 3.9%, 5.7% and 4.3%, respectively (see figure 1, right panel and online supplemental table S6, column 2). As with the vaccination intentions, the effect of the self-protection message is small and non-significant (−0.3 points, 95% CI −0.036, 0.031). We can reject the null hypotheses that the treatments have a null effect (p value of joint orthogonality of the four treatments: 0.024). We can also reject the null hypothesis that the altruistic messages have the same effect as the self-protection message (two-sided test of difference between treatment effects, p value: 0.010). Averaging across all three altruistic treatments, the impact on actual vaccination was 3.1 ppts, or 4.6% of the mean in the control group (0.671), which is similar to the average 3.0 points impact on intentions, or 4.8% of the mean in the control group (0.626). The effects of the different messages on vaccination uptake also mirror those on vaccination intentions in the initial wave (see the two panels of figure 1). To account for attrition between the first and the second waves of the survey, we estimate the effects of the four interventions on vaccination intentions and vaccination uptake, controlling for demographic characteristics. Online supplemental table S8 shows that our results are robust to adding these controls.

The effects of the different messages are sizeable, suggesting that attitudes and behaviour regarding COVID-19 vaccination were particularly malleable at the time of the survey. This is consistent with the fact that, in December 2020, the introduction of COVID-19 vaccines and accompanying debates were very recent, so that few people had reached a definitive opinion, while the timing and speed of vaccination campaigns was still uncertain so that many people had not yet decided whether they would get vaccinated if this possibility was offered to them.

We conducted our analysis for subgroups of respondents of a certain age range, gender and education level.

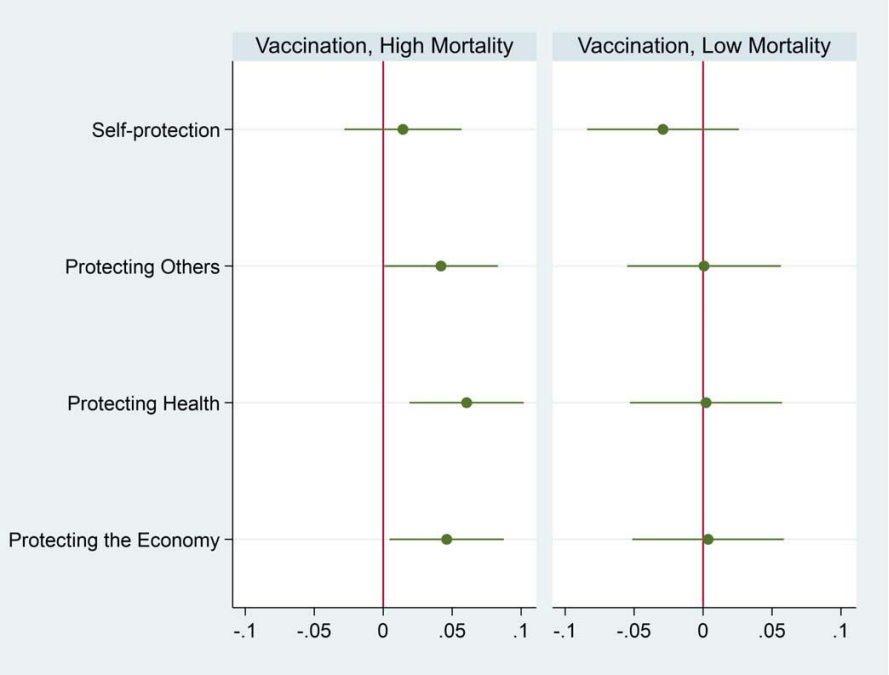


Figure 2 Effects of alternative informational interventions on vaccination uptake in high and low-mortality countries. Point estimates and 95% CIs for each of the four treatments (self-protection, protecting others, protecting health and protecting the economy), from regressions using pooled data and the outcome variable 'Vaccination' and also controlling for country fixed effects. In the left panel, we restrict the sample to high-mortality countries (3916 observations), in the right panel we restrict the sample to low-mortality countries (2463 observations).

We do not find any significant impact heterogeneity for any of these dimensions. Online supplemental table S9 reports results by subgroups when all treatments are pulled together, in order to increase statistical power.

Comparing effects across countries

Altruistic messages have different effects depending on the disease context, as can be seen in the two panels of figure 2 (and in online supplemental table S6, columns 3 and 4). In a nutshell, no message has any effect in low-mortality countries (Australia, Germany and New Zealand, with less than 37 deaths per 100 000 inhabitants on 28 December 2020, see online supplemental table S3). By contrast, in high-mortality countries (Austria, France, Italy, Sweden, the UK and the USA, with more than 68 deaths per 100 000 inhabitants on 28 December 2020, see online supplemental table S3), the effects of altruistic messages on vaccination rates are large: 4.2 ppts for protecting others (95% CI 0.001, 0.083), 6.0 ppts for protecting health (95% CI 0.019, 0.102) and 4.6 ppts for protecting the economy (95% CI 0.005, 0.088), which account for 5.6%, 8.0% and 6.2% of the mean in the control group (see online supplemental table S6, column 3). The effect of the self-protection message is small and non-significant (1.4 points, p value: 0.509, 95% CI −0.029, 0.058). We can again reject the null hypothesis that the altruistic messages have the same effect as the self-protection message (two-sided test of difference between treatment effects, p value: 0.027). Once again, we also reject the null of joint orthogonality of the four treatments (p value: 0.002).

In high-mortality countries, we observe a correlation between the impacts of the different messages on vaccination intentions and vaccination uptake, as shown in online supplemental figure S1. Together with the correlation observed in figure 1, this pattern suggests that the impacts on intentions may have mediated effects on actual vaccination. The fact that respondents were asked to state their intentions shortly after receiving the messages may have contributed to an impact on actual behaviour, consistent with psychological studies showing that intentions are more likely to translate into actual behaviour when they are stated explicitly.[22 23]

DISCUSSION

The most striking result of this experiment is that informational treatments provided in December 2020 affected immediate vaccination intentions and actual vaccination rates recorded 6 months later.

Our comparison of three altruism-based communication messages with conventional self-protection messaging also reveals that, overall, altruistic messages had a substantially greater effect on both vaccine intention and vaccination rates. There was little or no effect of messaging on self-protection, the standard WHO approach, in our study. The positive effects of altruism-based messaging were strong when focusing on risks to others, risks to population health and towards the economy. Overall, these communication messages based on altruism had more pronounced effects in countries where mortality rates from COVID-19 were high.

These findings add to a growing literature on the use of messages to influence vaccine intentions. The results from existing studies are complex. In brief, certain messages can influence vaccine intention for some people at some times.[24] However, the effects vary depending on the vaccine in question, the prevailing context (consistent with our finding of differences between high and low-mortality countries) and the characteristics of targeted individuals, such as the relative emphasis they place on the present versus the future.[25] One study undertaken during the COVID-19 pandemic found that responses to messages were moderated by the desire to travel as it required evidence of vaccination.[26]

Our study is unusual in that, unlike almost all studies of the effect of messaging that have measured impacts on intention, we have been able to follow-up individuals to assess their actual uptake of the vaccine, at least as they report it. We have found one other study, from Israel, that randomised members of a health maintenance organisation to reminders that emphasised either personal or social benefit and reported changes in vaccination behaviour over the next few days but we are unaware of any previous study on longer term impacts, at least in relation to COVID-19.[27] One review published just prior to the pandemic noted the lack of research on the long-term effects of interventions designed to change behaviour.[28] Given the substantial impact observed in our study, it should be a priority for future research to determine whether the duration of effect that we identified can be replicated in other contexts and, if so, which mechanisms are involved. One of the most widely used models of behaviour change is COM-B, which considers capability, opportunity and motivation.[29] Logically, what we observe must be linked to motivation but it is not possible, from our data, to determine with certainty why the effect lasted.

Our study has several limitations. First, reports of vaccination intentions elicited immediately after the messaging may be subject to social desirability bias: individuals may exaggerate their intention to get vaccinated to comply with social norms after receiving messages on the importance of doing so. However, if this was driving our results, we should expect it to affect all messages. It is therefore reassuring to find a significant difference between the effects induced by the altruistic messages and the self-protection message. Exposure to altruistic messaging could in theory encourage some misreporting of vaccine intention, contributing to the differential impact that we find. However, social desirability bias is less likely to play a role in self-declared vaccination uptakes, both because the information messages were received 6 months earlier and because individuals were asked to report their actual behaviour rather than their intentions. Hence, misreporting about actual vaccination amounts to telling a clear lie. Additionally, there is no clear reason to expect such misreporting to occur more in the treatment groups than in the control group—but only such differential misreporting would bias our estimates. Nonetheless, future research would, ideally, seek to link responses to medical records, as in a recent Israeli study.[27]

Second, individual attitudes and behaviour with respect to COVID-19 vaccination have evolved over time and we only measure them in December 2020 and 6 months later. Other research that has examined perceived vaccination risk, confidence and acceptance across countries and over time has found overall national levels of each outcome to remain relatively stable even if the attitudes and behaviour of some individuals change.[30] Given the many and often contradictory messages that people receive, the information we provided may eventually be concealed in subsequent noise but this should be an area for future research.

Third, the survey was designed as a rotating panel.[16] However, some differences emerge between the demographic characteristics of the respondents from the first wave who remained in the second wave, when the question on uptake vaccination was posed, and of those who dropped from the sample after the first wave. It is reassuring that we obtain nearly identical effects of the four interventions on vaccination intentions when we use the full sample of participants in the first wave (10 895 observations) or only the respondents to both waves (6379 observations). It is equally comforting that the estimated effects of the four interventions on vaccination intentions and vaccination uptake are robust to controlling for the demographic characteristics that differ between respondents remaining or leaving the sample after the first wave. These results suggest that any attrition bias occurring between the two surveys is not affecting our findings.

Fourth, while our overall sample size is large and our respondents span nine countries, we do not have sufficient statistical power to conduct country-specific analyses. However, we do compare the effectiveness of our treatments across two subsets of countries. The striking differences that we find in the relative impact of messages across high and low-mortality countries suggest that information campaigns employing an altruistic narrative are successful in difficult times, that is, when they are most needed—for instance, when a country is facing high mortality from a pandemic. This result offers optimism about the role of public policy campaigns during health crises. Yet, the lack of any significant effect of the messages in low-mortality countries raises doubts about the effectiveness of public policy campaigns when individuals are not overly concerned about the health risk, even from an ongoing global pandemic. Furthermore, there may be country-specific factors that we were unable to take into account. For instance, one recent study, using a similar approach but without follow-up to assess vaccine uptake, found that when exposed to individualistic or collective messages, Americans with high exposure to conservative media were more likely to be swayed by the former message.[31] Another American study found that appeals to economic self-interest were effective among Republicans.[32] However, the USA stands

out by virtue of the highly partisan nature of its vaccine discourse.

Finally, we were limited to only nine countries and it would be good, should the opportunity arise, to replicate this work in more countries, and with larger samples that would make it possible to test additional messages and hypotheses, including the impact of specific national factors.

Contributors VG, VP and PP did the conceptualisation of the research question, the data curation, the formal analysis and the writing of the paper. VG, VP, PP, MB, SB and MF participated in the design of the survey questionnaire and of the experiment and in securing funding for the project. MM and DS contributed to the writing of the final version of the paper. VG is responsible for the overall content as guarantor.

Funding Survey data from the project Attitudes on COVID-19: A Comparative Study, chaired by SB and MF (Sciences Po). Financial support from ANR (French Agency for Research)–REPEAT grant (Special COVID-19), French region Nouvelle Aquitaine (AMI, COVID-19) and UniCredit Foundation is gratefully acknowledged.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and the December 2020 and the June/July 2021 waves of the survey received ethics approval from IE University (IERC-12/2020-2021 and IERC-30/2020-2021). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

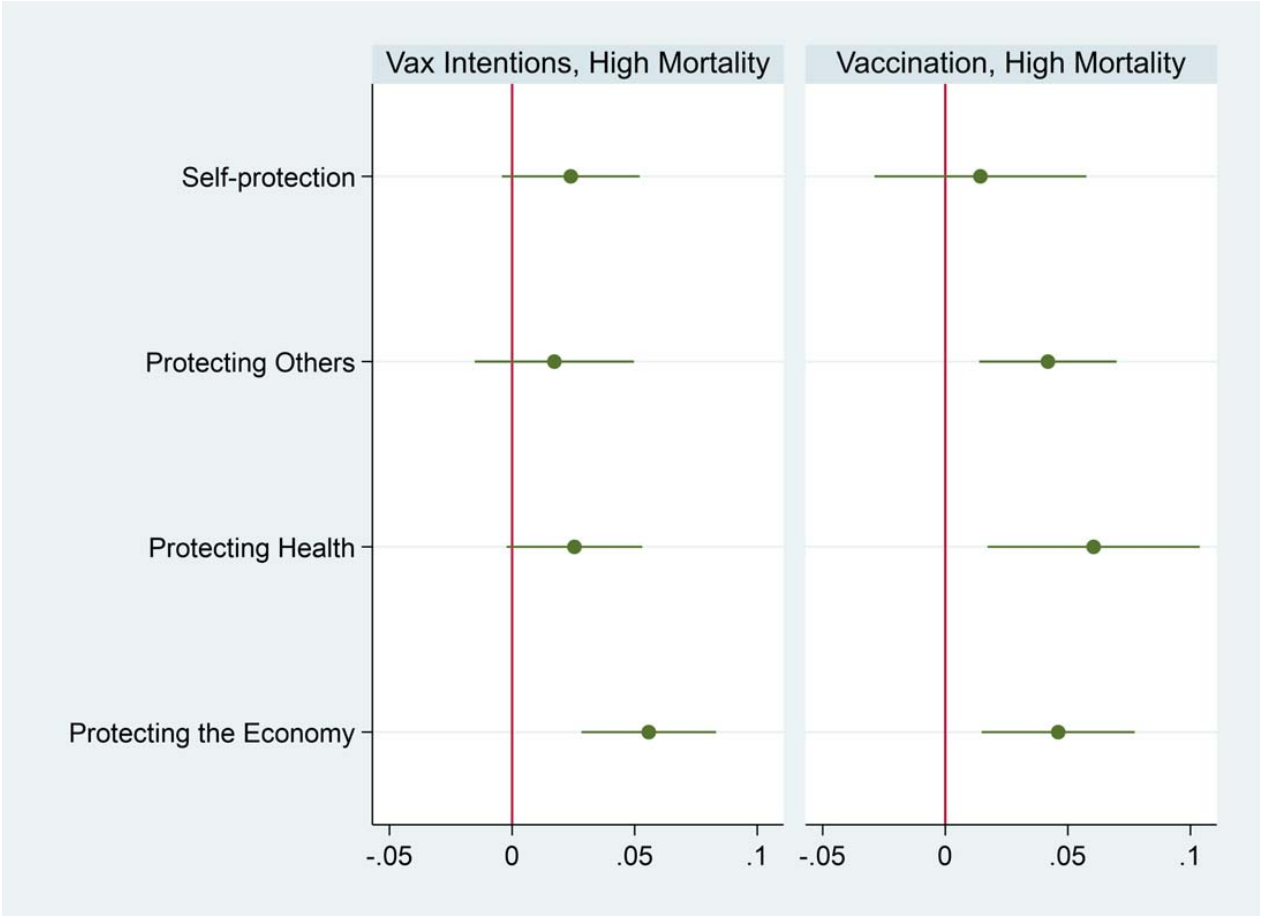
Data availability statement Data are available in a public, open access repository. While a part of our survey data is already public, the full data and codes are available in Vincenzo Galasso's Harvard Dataverse at https://doi.org/10.7910/DVN/FYDRYP

ORCID iDs
Vincenzo Galasso http://orcid.org/0000-0002-3882-0587
Martin McKee http://orcid.org/0000-0002-0121-9683

REFERENCES

1 Lazarus JV, Wyka K, White TM, *et al*. Revisiting COVID-19 vaccine hesitancy around the world using data from 23 countries in 2021. *Nat Commun* 2022;13:3801.
2 Our World in Data. Explore the global situation 2023, Available: https://ourworldindata.org/coronavirus#explore-the-global-situation
3 Truong J, Bakshi S, Wasim A, *et al*. What factors promote vaccine hesitancy or acceptance during Pandemics? A systematic review and thematic analysis. *Health Promot Int* 2022;37:daab105.
4 Jarrett C, Wilson R, O'Leary M, *et al*. Strategies for addressing vaccine hesitancy - A systematic review. *Vaccine* 2015;33:4180–90.
5 Dubé E, Gagnon D, Nickels E, *et al*. Mapping vaccine hesitancy--country-specific characteristics of a global phenomenon. *Vaccine* 2014;32:6649–54.
6 MacDonald NE, SAGE Working Group on Vaccine Hesitancy. Vaccine hesitancy: definition, scope and determinants. *Vaccine* 2015;33:4161–4.
7 Salmon DA, Dudley MZ, Glanz JM, *et al*. Vaccine hesitancy: causes, consequences, and a call to action. *Vaccine* 2015;33 Suppl 4:D66–71.
8 Larson HJ, Cooper LZ, Eskola J, *et al*. Addressing the vaccine confidence gap. *Lancet* 2011;378:526–35.
9 Kaplan RM, Milstein A. Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance. *Proc Natl Acad Sci U S A* 2021;118:e2021726118.
10 Whitehead HS, French CE, Caldwell DM, *et al*. A systematic review of communication interventions for countering vaccine misinformation. *Vaccine* 2023;41:1018–34.
11 Cai W, Zhou Y. Men smoke less under the COVID-19 closure policies: the role of altruism. *Soc Sci Med* 2022;306:S0277-9536(22)00465-8.
12 Böhm R, Betsch C, Korn L. Selfish-rational non-vaccination: experimental evidence from an interactive vaccination game. *J Eco Behav Organiz* 2016;131:183–95.
13 Rieger MO. Triggering altruism increases the willingness to get vaccinated against COVID-19. *Soc Health Behav* 2020;3:78.
14 Cucciniello M, Pin P, Imre B, *et al*. Altruism and vaccination intentions: evidence from behavioral experiments. *Soc Sci Med* 2022;292:S0277-9536(21)00527-X.
15 Zhu P, Tatar O, Griffin-Mathieu G, *et al*. The efficacy of a brief, altruism-eliciting Video intervention in enhancing COVID-19 vaccination intentions among a population-based sample of younger adults: randomized controlled trial. *JMIR Public Health Surveill* 2022;8:e37328.
16 Brouard S, Foucault M, Michel E, *et al*. Citizens' attitudes under Covid19', a cross-country panel survey of public opinion in 11 advanced democracies. *Sci Data* 2022;9:108.
17 Galasso V. Replication data for: addressing vaccine hesitancy: experimental evidence from nine high-income countries during the COVID-19 pandemic. *Harvard Dataverse* 2023. 10.7910/DVN/FYDRYP Available: https://doi.org/10.7910/DVN/FYDRYP
18 World Health Organization. Coronavirus disease (COVID-19): herd immunity, Lockdowns and COVID-19 2020. 2020. Available: https://www.who.int/news-room/questions-and-answers/item/herd-immunity-lockdowns-and-covid-19
19 Betsch C, Böhm R, Korn L, *et al*. On the benefits of explaining herd immunity in vaccine advocacy. *Nat Hum Behav* 2017;1:0056.
20 Shim E, Chapman GB, Townsend JP, *et al*. The influence of altruism on influenza vaccination decisions. *J R Soc Interface* 2012;9:2234–43.
21 Vietri JT, Li M, Galvani AP, *et al*. Vaccinating to help ourselves and others. *Med Decis Making* 2012;32:447–58.
22 Greenwald AG, Carnot CG, Beach R, *et al*. Increasing voting behavior by asking people if they expect to vote. *J App Psychol* 1987;72:315–8.
23 Morwitz VG, Johnson E, Schmittlein D. Does measuring intent change behavior *JConsum Res* 1993;20:46. 10.1086/209332 Available: http://www.journals.uchicago.edu/toc/jcr/20/1
24 Penţa MA, Băban A. Message framing in vaccine communication: a systematic review of published literature. *Health Commun* 2018;33:299–314.
25 Nan X. Relative persuasiveness of gain-versus loss-framed human Papillomavirus vaccination messages for the present-and future-minded. *Hum Commun Res* 2012;38:72–94. 10.1111/j.1468-2958.2011.01419.x Available: http://doi.wiley.com/10.1111/hcre.2012.38.issue-1
26 Gursoy D, Ekinci Y, Can AS, *et al*. Effectiveness of message framing in changing COVID-19 vaccination intentions: moderating role of travel desire. *Tour Manag* 2022;90:104468.
27 Berliner Senderey A, Ohana R, Perchik S, *et al*. n.d. Encouraging uptake of the COVID-19 vaccine through behaviorally informed interventions: national real-world evidence from Israel. *SSRN Journal*
28 International Conference on Games and Learning Alliance. *Putting the long-term into behavior change*. Springer, 2018.
29 Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for Characterising and designing behaviour change interventions. *Implement Sci* 2011;6:42.
30 Martinelli M, Veltri GA. COVID-19 vaccine acceptance: A comparative longitudinal analysis of the association between risk perception, confidence, and the acceptance of a COVID-19 vaccine. *Risk Anal* 2023.
31 Borah P. Message framing and COVID-19 vaccination intention: moderating roles of partisan media use and pre-attitudes about vaccination. *Curr Psychol* 2022;2022:1–10.

32 Zhong W, Broniatowski DA. Economic risk framing increases intention to vaccinate among Republican COVID-19 vaccine Refusers. *Soc Sci Med* 2023;317:115594.


Vax Intentions, High Mortality
Vaccination, High Mortality
Self-protection
Protecting Others
Protecting Health
Protecting the Economy
-.05
0
.05
.1
-.05
0
.05
.1

Supplementary Material

Addressing Vaccine Hesitancy: Experimental Evidence from Nine High-Income Countries during the COVID-19 Pandemic

Fig. S1: Effects of Alternative Informational Interventions on Vaccination Intentions and Vaccination Uptake in High Mortality Countries

Notes: Point estimates and 95% confidence intervals for each of the four treatments (Self-protection, Protecting Others, Protecting Health, and Protecting the Economy), from regressions using pooled data and the outcome variables "Vaccination Intentions" (left panel) and "Vaccination" (right panel) in High Mortality Countries and also controlling for country fixed effects.

Table S1: Dates of the Survey's December 2020 and June/July 2021 Waves

	Dates of the Survey's December 2020 Wave	Dates of the Survey's June/July 2021 Wave	Number of Respondents Surveyed in Both Waves
Australia	4-10 December 2020	June 28-July 8 2021	343
Austria	5-9 December 2020	July 1-July 13 2021	324
France	2-5 December 2020	June 29-July 8 2021	850
Germany	5-9 December 2020	June 30-July 7 2021	1481
Italy	5-7 December 2020	June 29-July 6 2021	710
New Zealand	5-9 December 2020	June 29-July 10 2021	639
Sweden	5-9 December 2020	June 30-July 8 2021	693
U.K.	5-8 December 2020	June 29-July 9 2021	697
U.S.	4-11 December 2020	June 28-July 8 2021	642

Table S2: Rotating Panel, Attrition on demographics

VARIABLES	(1) Demographics	(2) Demo & Intentions
Fifty plus (50+)	0.125***	0.124***
	[0.010]	[0.010]
Women	-0.058***	-0.057***
	[0.009]	[0.009]
Less than High School	-0.023	-0.023
	[0.016]	[0.016]
No exposure to Covid	0.059***	0.059***
	[0.010]	[0.010]
Live with others	-0.064***	-0.064***
	[0.017]	[0.017]
Live with family	-0.019*	-0.019*
	[0.010]	[0.010]
Informed (radio)	0.003	0.003
	[0.003]	[0.003]
Informed (newpaper)	0.003	0.003
	[0.003]	[0.003]
Informed (social)	-0.091***	-0.090***
	[0.016]	[0.016]
Informed (internet)	0.007**	0.007**
	[0.003]	[0.003]
Politics: Liberal	0.029*	0.028
	[0.018]	[0.018]
Politics: Centrist	0.033**	0.032**
	[0.016]	[0.016]
Politics: Conservative	0.033*	0.033*
	[0.017]	[0.017]
Vaccination Intentions		0.009
		[0.014]
Constant	0.304***	0.299***
	[0.025]	[0.025]
Observations	10,852	10,852
R-squared	0.153	0.153

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions.

Table S3: Mortality and Vaccination Statistics

	GDP Growth Rate in 2020	Mortality Rate (28 Dec, 2020)	Mortality Rate (30 June, 2021)	Vaccination Rate (30 June, 2021)	Vaccination Starting Date	Open-to-all-adult Date	Groups with Vaccination Mandate
Australia	-1.3	3.6	3.6	23.7%	February 2021	August 2021	Healthcare workers; 70+; 40+.
Austria	-7.1	68.5	120.5	53.2%	January 2021	May 2021	Healthcare staff & 80+; selected workers & 65+.
France	-8.0	93.6	165.9	50.8%	December 2020	June 2021	Care givers 50+; 75+; 65+; 50+ & with co-morbidities.
Germany	-4.7	36.1	109.3	55.3%	December 2020	June 2021	Medical personnel & 80+; 70+ & with preconditions; 60+.
Italy	-8.6	118.5	211.5	57.0%	December 2020	June 2021	Healthcare workers & 80+; 70+; 60+ & with co-morbidities.
New Zealand	-3.4	0.5	0.5	14.1%	February 2021	July 2021	Healthcare workers; 65+ & with preconditions.
Sweden	-3.6	81.3	142.2	48.5%	December 2020	July 2021	Healthcare workers; 65+; people with preconditions, 55+.
U.K.	-9.6	106.5	192.1	65.8%	December 2020	February 2021	Healthcare workers & 50+.
U.S.	-4.3	101.5	184.1	54.7%	December 2020	April 2021	

Notes: GDP growth rate from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG. Mortality rates measure deaths per 100,000 inhabitants on 28 December 2020 and 30 June 2021, from https://coronavirus.jhu.edu/data/mortality. Vaccination rates are the ratio of people who received at least one vaccination dose over the total population by 30 June 2021, from https://ourworldindata.org/covid-vaccinations.

Table S4: Summary Statistics

	Obs	Mean	Std. dev.	Min	Max
18-34 yo	6379	0.17	0.38	0	1
35-49 yo	6379	0.27	0.44	0	1
50-59 yo	6379	0.19	0.4	0	1
60+	6379	0.36	0.48	0	1
Women	6379	0.49	0.5	0	1
White collars	6379	0.17	0.37	0	1
Service workers	6379	0.31	0.46	0	1
Blue collars	6379	0.14	0.35	0	1
Inactive	6379	0.38	0.49	0	1
No High School	6379	0.09	0.29	0	1
High school	6379	0.52	0.5	0	1
College	6379	0.39	0.49	0	1
Media Info	6375	0.58	0.22	0.2	1
Social Info	6371	0.51	0.32	0.2	1
Compliance	6379	0.74	0.22	0	1
Live w/family	6379	0.64	0.48	0	1
COVID	6379	0.04	0.2	0	1
Others w/COVID	6379	0.24	0.43	0	1
Prob COVID	6379	0.52	0.29	0	1
Prob Seriously Ill	6379	0.55	0.28	0	1
Live w/Family	6379	0.64	0.48	0	1
Conservative	6379	0.24	0.43	0	1
Centrist	6379	0.45	0.5	0	1
Liberal	6379	0.22	0.41	0	1
Undeclared Ideology	6379	0.09	0.28	0	1
Trust in Scientists	6378	0.84	0.37	0	1
Risk Aversion	6252	0.57	0.26	0	1
Big Pharma's Fault	6275	0.26	0.32	0	1

China's Fault	6253	0.32	0.34	0	1
Vaccines' Side Effects	6379	0.51	0.31	0	1
Vaccine Intentions	6379	0.65	0.34	0	1
Self Protection	6379	0.2	0.4	0	1
Protecting Others	6379	0.2	0.4	0	1
Protecting Own Country	6379	0.2	0.4	0	1
Protecting the Economy	6379	0.2	0.4	0	1

Table S5: Balance Tests (Panel A)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
VARIABLES	18-34 yo	35-49 yo	50-59 yo	60+	Women	High school	College	Service workers	Blue collar workers	Inactive	Traditional media consumption	Social media consumption	Compliance
Self-protection	-0.036**	0.025	0.018	-0.008	0.005	0.021	-0.028	-0.000	-0.017	0.027	-0.006	0.015	0.011
	[0.017]	[0.018]	[0.017]	[0.018]	[0.019]	[0.020]	[0.018]	[0.022]	[0.015]	[0.021]	[0.007]	[0.013]	[0.010]
Protecting Others	-0.023	0.001	0.019	0.003	0.006	0.011	-0.002	-0.006	-0.016	0.008	-0.007	0.013	0.007
	[0.016]	[0.016]	[0.013]	[0.019]	[0.019]	[0.018]	[0.016]	[0.023]	[0.015]	[0.018]	[0.009]	[0.012]	[0.008]
Protecting Health	-0.026	0.009	0.003	0.014	0.003	0.022	-0.000	-0.007	-0.026*	0.028	-0.001	-0.001	0.014**
	[0.019]	[0.018]	[0.016]	[0.018]	[0.022]	[0.021]	[0.018]	[0.023]	[0.016]	[0.019]	[0.008]	[0.012]	[0.007]
Protecting the Economy	-0.032*	0.003	-0.006	0.035*	-0.031*	-0.021	0.012	-0.038*	-0.016	0.041**	0.005	0.006	0.005
	[0.016]	[0.016]	[0.014]	[0.020]	[0.017]	[0.020]	[0.020]	[0.020]	[0.014]	[0.020]	[0.009]	[0.010]	[0.010]
Mean Outcome	0.173	0.268	0.195	0.364	0.487	0.519	0.389	0.311	0.142	0.381	0.583	0.508	0.742
Observations	6,379	6,379	6,379	6,379	6,379	6,379	6,379	6,379	6,379	6,379	6,375	6,371	6,379
R-squared	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000

Table S5: Balance Tests (Panel B)

VARIABLES	(14) Live w/family	(15) COVID	(16) Others w/COVID	(17) Prob COVID	(18) Prob seriously ill	(19) Conservative	(20) Undeclared ideology	(21) Trust in scientists	(22) Risk aversion	(23) Big pharma's fault	(24) China's fault	(25) Vaccines' side effects	(26) Attrition
Self-protection	-0.025	-0.000	-0.022	0.011	-0.005	-0.018	0.008	0.022	0.005	-0.010	-0.011	-0.004	-0.014
	[0.018]	[0.008]	[0.019]	[0.010]	[0.010]	[0.013]	[0.010]	[0.015]	[0.009]	[0.016]	[0.013]	[0.013]	[0.014]
Protecting Others	-0.019	0.002	-0.006	0.017	0.006	-0.006	0.020*	0.034**	0.002	0.005	0.004	-0.002	-0.018
	[0.018]	[0.007]	[0.016]	[0.011]	[0.009]	[0.014]	[0.011]	[0.015]	[0.009]	[0.013]	[0.013]	[0.010]	[0.013]
Protecting Health	0.009	-0.003	0.004	0.005	0.001	0.003	0.002	0.013	0.001	-0.008	0.011	-0.021*	0.002
	[0.019]	[0.007]	[0.017]	[0.012]	[0.011]	[0.015]	[0.011]	[0.018]	[0.011]	[0.013]	[0.012]	[0.011]	[0.016]
Protecting the Economy	-0.024	-0.005	-0.022	0.010	0.011	-0.007	0.001	0.017	-0.016*	-0.016	0.003	-0.007	-0.007
	[0.019]	[0.006]	[0.017]	[0.010]	[0.010]	[0.017]	[0.009]	[0.014]	[0.009]	[0.013]	[0.012]	[0.014]	[0.013]
Mean Outcome	0.640	0.041	0.238	0.520	0.549	0.242	0.088	0.836	0.573	0.264	0.319	0.506	0.414
Observations	6,379	6,379	6,379	6,379	6,379	6,379	6,379	6,378	6,252	6,275	6,253	6,379	10,895
R-squared	0.001	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.000

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions.

*** p<0.01, ** p<0.05, * p<0.1

Table S6: Effects of Experimental Treatments

VARIABLES	(1) Intentions All	(2) Vaccination All	(3) Vaccination High Mortality	(4) Vaccination Low Mortality
Self-protection	0.012	-0.003	0.014	-0.029
	[0.013]	[0.018]	[0.022]	[0.032]
Protecting Others	0.022*	0.026*	0.042***	0.001
	[0.012]	[0.015]	[0.014]	[0.032]
Protecting Health	0.030**	0.038**	0.060***	0.002
	[0.013]	[0.018]	[0.022]	[0.034]
Protecting the Economy	0.038***	0.029*	0.046***	0.004
	[0.012]	[0.016]	[0.016]	[0.034]
Mean Outcome	0.647	0.691	0.780	0.551
Mean Outcome in Control Group	0.626	0.671	0.746	0.553
Observations	6,379	6,379	3,916	2,463
R-squared	0.062	0.161	0.024	0.205
P-value of H: Joint orthogonality	0.024	0.036	0.002	0.688
P-value of H: Difference between treatment effects = 0	0.072	0.010	0.027	0.167

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions. The table reports the p-value of the joint orthogonality test for the four coefficients and the p-value of the test of the null that the effects of the altruistic messages and the self-protection message were identical.

Table S7: Effects of Experimental Treatments on Vaccination Intentions (Panel component and 1st Wave)

VARIABLES	(1) Intentions Panel	(2) Intentions 1st wave
Self-protection	0.012	0.018*
	[0.013]	[0.010]
Protecting Others	0.022*	0.028***
	[0.012]	[0.010]
Protecting Health	0.030**	0.026**
	[0.013]	[0.010]
Protecting the Economy	0.038***	0.028***
	[0.012]	[0.010]
Mean Outcome	0.647	0.638
Mean Outcome in Control Group	0.626	0.619
Observations	6,379	10,895
R-squared	0.062	0.059
P-value of H: Joint orthogonality	0.024	0.021
P-value of H: Difference between treatment effects = 0	0.072	0.236

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions. The table reports the p-value of the joint orthogonality test for the four coefficients and the p-value of the test of the null that the effects of the altruistic messages and the self-protection message were identical.

Table S8: Effects of Experimental Treatments (including individual controls)

VARIABLES	(1) Intentions All	(2) Vaccination All	(3) Vaccination High Mortality	(4) Vaccination Low Mortality
Self-protection	0.016	0.002	0.013	-0.014
	[0.013]	[0.017]	[0.021]	[0.027]
Protecting Others	0.027**	0.027*	0.042**	0.007
	[0.013]	[0.016]	[0.020]	[0.027]
Protecting Health	0.030**	0.036**	0.059***	0.003
	[0.013]	[0.016]	[0.021]	[0.027]
Protecting the Economy	0.036***	0.028*	0.042**	0.007
	[0.013]	[0.016]	[0.020]	[0.027]
Individual controls	Yes	Yes	Yes	Yes
Mean Outcome	0.647	0.691	0.780	0.551
Mean Outcome in Control Group	0.626	0.671	0.746	0.553
Observations	6,363	6,363	3,906	2,457
R-squared	0.144	0.218	0.094	0.264
P-value of H: Joint orthogonality	0.042	0.084	0.025	0.939
P-value of H: Difference between treatment effects = 0	0.133	0.030	0.032	0.383

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions. The table reports the p-value of the joint orthogonality test for the four coefficients and the p-value of the test of the null that the effects of the altruistic messages and the self-protection message were identical. Individual controls include: Age dummy (50+), gender, Education dummy (Less than High School), No direct exposure to COVID, Living arrangement dummies (live with others, live with family), dummies for level of information from different sources (radio, newpaper, social, internet), dummies for political orientation (Liberal, Centrist, Conservative).

Table S9: Heterogenous effects

VARIABLES	(1) Intentions Women	(2) Vaccination Women	(3) Intentions College	(4) Vaccination College	(5) Intentions Aged 50+	(6) Vaccination Aged 50+
Treatment	0.033***	0.025	0.024**	0.023	0.011	0.016
	[0.012]	[0.019]	[0.011]	[0.018]	[0.011]	[0.021]
Women	-0.070***	-0.048*				
	[0.015]	[0.025]				
Treatment * Women	-0.016	-0.005				
	[0.016]	[0.027]				
College			0.066***	0.050**		
			[0.015]	[0.025]		
Treatment * College			0.004	-0.000		
			[0.016]	[0.027]		
Aged 50+					0.084***	0.184***
					[0.015]	[0.024]
Treatment * Aged 50+					0.026	0.004
					[0.016]	[0.027]
Constant	0.693***	0.786***	0.626***	0.738***	0.624***	0.663***
	[0.013]	[0.023]	[0.012]	[0.023]	[0.012]	[0.025]
Observations	10,895	6,379	10,895	6,379	10,895	6,379
R-squared	0.073	0.163	0.068	0.163	0.082	0.200

Notes: Standard errors clustered at the region-country level in brackets. Country fixed effects used in all regressions.

Supplementary Information

Our survey data are part of the CAUCP project, which collected information on behavioral and attitudinal reactions to COVID-19 related policies and on related behavior and attitudes. Nearly identical questionnaires were administered in all countries for each wave of the CAUCP survey, but some response categories were adapted to country-specific characteristics, such as political parties.

Both the December 2020 and June/July 2021 survey waves recorded individuals' attitudes and behavior towards COVID-19 and COVID-19 vaccination. In the June/July 2021 wave, individuals were asked whether they had already received one or two doses of a COVID-19 vaccine or none. Our vaccination dummy takes value 1 if individuals said they received at least one dose, and 0 otherwise. The surveys also collected self-reported information on individuals' socio-demographic characteristics including age (four age groups: 18-34, 35-49, 50-59, and 60+), gender, type of occupation (white collar, blue collar, service workers, and inactive), level of education (no high school, high school, and college), living arrangements (living with family, living alone, and living with friends), political orientation (liberal, centrist, or conservative, corresponding respectively to 0-3, 4-6, and 7-10 on the 0-10 scale of political ideology from left to right), and level of information. We capture consumption of traditional media by averaging the responses to questions on how often respondents get information about COVID-19 from (a) TV; (b) the radio; and (c) printed newspapers, with possible answers being never (corresponding to category 1), 1 or 2 days a week (2), 3 or 4 days a week (3), 5 or 6 days a week (4), or every day (5). We also use information on how often individuals get information from social media, on the same 1-5 scale.

The surveys collected information on respondents' experiences, expectations, and behavior on COVID-related issues. Individuals reported whether they – or their relatives or friends – had been infected with COVID-19. They were asked how likely they think they are to be infected if they return to their normal life (on a 0–10 scale) and how likely they think they are to become seriously ill if infected (on a 0–10 scale). Moreover, individuals reported their level of risk aversion, by answering

how difficult it is for them to accept health risks (on a 0–10 scale). The December 2020 wave also collected information (on a 0–10 scale) about individuals' compliance with several COVID-19 related health and social distancing rules, which were in place in most countries in our sample (or about to be reintroduced), such as coughing into one's elbow, stopping hugging or greeting, avoiding crowded places, and wearing face masks.

To measure confidence towards COVID-19 vaccines, we asked questions on trust in scientists, as well as beliefs regarding conspiracy theories and the COVID-19 vaccine trial procedure. In both waves, respondents were asked how much they trust scientists (on a 1–4 scale, from "not at all" to "completely") and how much they believe the following two statements to be true, on a 0-10 scale (from completely unlikely to very likely): (i) "The virus has been created by large corporations because some of them can directly profit from it" and (ii) "The virus was created by China to increase its power in the world." These two statements report two of the most common conspiracy theories at the time. In the second wave, on a 0-10 scale (from completely unlikely to very likely), respondents were asked whether they believe that, due to the expedition of clinical trials, the possible negative consequences of COVID-19 vaccines were not fully analyzed.

All socio-demographic and attitudinal variables are well-balanced across the treatment and control groups, and the attrition rate from the first to the second wave is not significantly different across treatments: out of 104 coefficients shown in Table S4, four are significant at the 5% level and eight others at the 10% level, which is in line with what would be expected.

The total number of respondents to both surveys was 6379: 1257 were assigned to the control group (19.71%), 1287 to the Self-protection treatment (20.18%), 1297 to the altruism towards others treatment (20.33%), 1255 to the altruism towards the population treatment (19.67%), 1283 to the altruism towards the economy (20.11%).