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Let's call! Using the phone to increase vaccine acceptance

Alex Armand[1] | **Mattia Fracchia**[2] | **Pedro C. Vicente**[3]

[1]Nova School of Business and Economics, Universidade Nova de Lisboa, NOVAFRICA, CEPR, and Institute for Fiscal Studies, Carcavelos, Portugal

[2]Nova School of Business and Economics, Universidade Nova de Lisboa, NOVAFRICA, Carcavelos, Portugal

[3]Nova School of Business and Economics, Universidade Nova de Lisboa, NOVAFRICA, BREAD, and CEPR, Carcavelos, Portugal

Correspondence
Pedro C. Vicente.
Email: pedro.vicente@novasbe.pt

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Abstract

In the context of the COVID-19 pandemic, we develop and test experimentally three phone-based interventions to increase vaccine acceptance in Mozambique. The first endorses the vaccine with a simple positive message. The second adds the activation of social memory on the country's success in eradicating wild polio with vaccination campaigns. The third further adds a structured interaction with the participant to develop a critical view toward misleading information and minimize the sharing of fake news. We find that combining the endorsement with the stimulation of social memory and the structured interaction increases vaccine acceptance and trust in institutions.

KEYWORDS
acceptance, Africa, COVID-19, fake news, hesitancy, information, inoculation theory, misinformation, Mozambique, social memory, trust, vaccines

JEL CLASSIFICATION
O12, D83, D91, I12, I15

1 | INTRODUCTION

Effective control of infectious diseases depends not only on the prompt and extensive availability of vaccines but also on their widespread acceptance. As demonstrated in the recent COVID-19 pandemic, the sudden emergence of both the disease and the corresponding vaccines can pose a challenge in ensuring global acceptance (Lazarus et al., 2021; Solís Arce et al., 2021). The prevalence of misinformation surrounding novel vaccines can significantly reduce the likelihood of their acceptance and potentially impact the acceptance rates of existing vaccines (Barrera et al., 2020; Bursztyn et al., 2023; Gørtz et al., 2020). Addressing misinformation is thus crucial in achieving high levels of acceptance and controlling the spread of infectious diseases.

This study focuses on three primary obstacles to vaccine acceptance: limited awareness, low trust in institutions, and the proliferation of fake news among the public (Agosti et al., 2022; Cordoba-Sanchez et al., 2022; Hoy et al., 2022). To address these challenges, we designed three information-provision modules. The first (labeled as *endorsement*) works on awareness by conveying basic information about vaccination along with a positive message endorsing it. The second (labeled as *social memory*) aims at enhancing trust in institutions by leveraging the memory of the country's success in eradicating wild polio with vaccination. The third (labeled as *inoculation*) is a structured interaction between an enumerator and the participant to develop a critical view toward misleading information and minimize the sharing of fake news. Using these modules, we design three interventions in which modules are offered cumulatively (endorsement alone, endorsement with social memory, and endorsement with social memory as well as inoculation), and we contrast them against a scenario in which no module is provided.

In the context of the COVID-19 pandemic, we study how these interventions impact vaccine acceptance and trust in institutions, which is a crucial factor affecting vaccine acceptance (Lazarus et al., 2021). We implemented the interventions in a sample of Mozambican citizens at the time the first COVID-19 vaccines were being approved by the World Health Organization (WHO).[1] The pandemic had already heavily impacted low- and middle-income countries like Mozambique, resulting in

widespread food insecurity and falling living standards (Egger et al., 2021; Figueroa et al., 2021). To assess the effectiveness of the interventions, we employed a randomized controlled trial based on a pre-analysis plan (Armand, Fracchia, & Vicente, 2021). We use two sources of primary data: a panel phone survey and a set of behavioral measures based on text messages (SMSs). Behavioral measures are observable and costly actions that allow minimizing concerns about social desirability biases in the survey measures.

We find that the use of all three modules together effectively enhances the acceptance of COVID-19 vaccines and increases trust in health institutions. The social memory and inoculation modules are particularly effective in driving vaccine acceptance, whereas simple endorsements are primarily responsible for improving trust in institutions. Notably, we do not observe any evidence of social desirability bias influencing these effects.

These results contribute to the vast and diverse literature on information provision (Haaland et al., 2023), offering new evidence on how information campaigns can influence public health in low- and middle-income countries (Dupas, 2011). Despite recent research suggests that providing simple yet credible information can be effective in promoting preventive health behaviors (Alsan & Eichmeyer, 2021; Armand et al., 2022; Banerjee et al., 2020) and raising trust in institutions (Rafkin et al., 2021), there remains limited evidence on the effectiveness of alternative information campaign designs (see, e.g., Alsan et al., 2021).[2]

We contribute to the rapidly growing field of research on information campaign design by providing evidence on the effectiveness of combining simple endorsements with alternative methods of information delivery. First, we contribute to the understanding of the effects of stimulating positive collective memory. Evidence shows that activating social memory can have long-lasting effects on the demand for health services and on trust in health institutions. In the US, the disclosure of the Tuskegee Study of Untreated Syphilis in the Negro Male led to increased medical mistrust and mortality among African-American men (Alsan & Wanamaker, 2018). In Central Africa, higher exposure to colonial medical campaigns forcing individuals to receive injections with dubious efficacy and serious side effects are associated with lower vaccination rates and trust in medicine today (Lowes & Montero, 2021). In Pakistan, the Taliban's anti-vaccine propaganda was built on the social memory of American operations in the country and led to lasting negative effects on vaccination rates (Martinez-Bravo & Stegmann, 2021).

Second, we provide evidence of the effect of applying a structured interaction with the targeted population. Evidence shows that passive information campaigns have limited effectiveness against misinformation. Fact-checking spreads slower than misinformation, and corrections of misleading information may even backfire (Carey et al., 2020; Ecker et al., 2010; Lewandowsky et al., 2012; Nyhan & Reifler, 2010; Vosoughi et al., 2018). Instead, structured interactions with the targeted population can be more effective. For example, communication strategies based on the theory of psychological inoculation have successfully promoted resistance to false or misleading messages by exposing individuals to weakened versions of those messages in advance (Cook et al., 2017; McGuire, 1964; Miller et al., 2013). Despite this approach has been applied successfully to health messaging (Ivanov, 2012; Ivanov et al., 2016; Miller et al., 2007; Van der et al., 2020), and to promote vaccines (Wong, 2016; Wong & Harrison, 2014), it remains unclear whether this approach is effective in poorer settings like in low and middle-income countries. In line with Roozenbeek et al. (2020), we hypothesize that structured interactions are effective tools to impede the spread of misinformation in these settings.

The paper is organized as follows. Section 2 discusses the context of our experiment. Section 3 is dedicated to experimental design, including a description of treatments, randomization, sampling, and measurement, while Section 4 explains the estimation strategy. Section 5 presents the results, and Section 6 concludes.

2 | CONTEXT

Mozambique has a relatively high acceptance of vaccines in general. In 2018, the large majority of the population believed that vaccines are safe (92%) and important for children to have (97%), while a relatively smaller share believed that they are effective (77%) (Wellcome Global Monitor, 2018). In 2020, vaccination rates were 91% for tuberculosis (BCG), 79% for diphtheria, tetanus, and pertussis (DTP1), 81% for measles (MCV1), and 73% for polio (Pol3) (WHO, 2021b).[3]

The first case of COVID-19 was registered on March 1st, 2020. The country was hit by the pandemic while trying to recover from the hidden debt crisis of 2016, the violent insurgency in the northern province of Cabo Delgado that started in 2017, and the tropical cyclones of 2019. In 2020, the country registered its first economic contraction in 28 years, which increased the poverty rate from 62.5 to 64.0% (World Bank, 2021a). The setting of this study in Mozambique is thus one of economic crisis, likely implying a slowdown in the path toward meeting the Sustainable Development Goals and the progress made over the previous decades (UNICEF, 2021).

At the time of the study, COVID-19 vaccines were being approved by the WHO but were not widely available in Mozambique. The first COVID-19 vaccine to be inserted in the WHO Emergency Use Listing, the Pfizer/BioNTech Comirnaty vaccine, was approved on December 31st, 2020 (WHO, 2021a), just two months before the beginning of interventions, which started on February 18th and ended on March 6th, 2021.[4] Mozambique received the first 200,000 doses of COVID-19 vaccines only on February 24th, 2021, followed by 484,000 doses on March 8th, 2021 (Ministry of Health of Mozambique, 2021b,c; VOA, 2021). The national vaccination campaign was released on March 5th, with priority given to health professionals, the military, and the elderly (Ministry of Health of Mozambique, 2021d). The rollout of the campaign presented several challenges. Only 56% of health care facilities had access to basic water services and only 43% to basic sanitation services (WHO, 2020). In addition, health worker density was well below the average in Sub-Saharan Africa (SSA), with 0.08 physicians and 0.68 nurses and midwives per 1000 people, as compared to 0.23 physicians and 0.99 nurses and midwives per 1000 people in SSA (World Bank, 2021b).

3 | EXPERIMENTAL DESIGN

3.1 | Information modules and interventions

We analyze the impact of three interventions disseminating information in phone conversations. Each intervention builds from the following three modules. Appendices A1–A3 provide the scripts used in each module.

The *endorsement* module consists of a simple message providing information about the vaccination against COVID-19 and endorsing the vaccine. The message blends together information about the risks of the disease, detailing the health concerns about oneself and others and the benefits of getting vaccinated. This module includes the standard content of passive information provision to raise vaccine acceptance in the context of the COVID-19 pandemic.

The *social memory* module is a message designed to remind respondents about the successful eradication of wild polio in Mozambique through vaccination. Wild polio is a naturally occurring strain of the poliovirus. It causes poliomyelitis, a disease that can result in paralysis and even death (WHO, 2021d). Mozambique was declared free of wild poliovirus by the WHO in 2006, while the last case of poliomyelitis caused by wild virus strain was reported in 1993 (Cassocera et al., 2020).[5] The key strategy used in Mozambique's successful fight against polio was the integration of polio vaccination in the national vaccination campaigns starting in the 1980s. This strategy dramatically expanded vaccine coverage among children in both urban and rural areas (Cassocera et al., 2020). The aim of the module is thus to increase the level of trust in the national health system by reminding people of this successful vaccination campaign.

The *inoculation* module includes a structured interaction between the enumerator and the participant designed to raise awareness about the formation and diffusion of unverified and misleading information about COVID-19 vaccines. Participants are meant to develop a critical view toward unverified information conducive to minimizing the sharing of this information. This module builds from the theory of psychological inoculation (Compton, 2013; Compton et al., 2021; Compton et al., 2016; McGuire, 1964). Protection against persuasive messages like fake news can be obtained not by changing a person's position, like in passive information campaigns, but by triggering protective responses (e.g., enhanced critical thinking, fact-checking, etc.). Following the same logic of vaccination in medicine, this trigger is activated by exposing a person to weakened versions of these persuasive messages.

Standard versions of weakened messages usually consist of two parts. The first is a forewarning of a threat that motivates people to resist a persuasive message. In our study, we warn participants about the spread of misinformation related to COVID-19 vaccines and its consequences. However, since the module was implemented over the phone, we allowed participants to highlight their own fears while enumerators used this information to warn them about misinformation. This approach avoids the possibility of new misleading information gaining visibility or credibility with participants, which could have serious misinformation consequences in the COVID-19 context.

The second part of weakened messages is the preemptive refutation of counterarguments, also known as *pre-bunking*, which helps to weaken misinformation. While our module does not directly pre-bunk misleading claims about COVID-19 vaccines, we make use of the fears reported by the participant to expose the techniques used to produce rumors and fake news. In this way, we help participants to develop a critical view of unverified information and minimize its sharing. Our approach is in line with recent advancements in inoculation research that promote interventions' flexibility and scalability by exposing participants to the manipulation techniques behind misinformation (Brady et al., 2017; Lewandowsky et al., 2013; Roozenbeek & Van Der Linden, 2019; Van der Linden, 2015). Exposure to manipulation techniques has been shown to facilitate memory retention (Pfau et al., 1997, 2005).[6] Banas and Rains (2010) show that inoculation treatments are effective whether refutations

are provided by the messenger (passive refutation) or are generated by the participant (active refutations), as is the case in our module.

We design four different groups receiving cumulative combinations of these modules. First, a pure control group (C) receives no module at all. Second, a treatment 1 (T1) group receives only the *endorsement* module. Third, a treatment 2 (T2) group receives both the *endorsement* and the *social memory* modules. Finally, a treatment 3 (T3) group receives the *endorsement*, the *social memory*, and the *inoculation* modules.[7]

The division in control and treatment groups allows testing the effectiveness of the interventions, but not the effectiveness of providing the *social memory* or the *inoculation* modules alone. We can learn about the effectiveness of stimulating social memory, but only after having endorsed the vaccine. Similarly, we can learn about the effectiveness of inoculating against misleading information, but only after having endorsed the vaccine and having stimulated social memory. We did not opt for an active control group because the level of engagement is raised in both the control and the treatment groups by the fact that the intervention is implemented in conjunction with the survey. Moreover, we cover the same set of questions for all groups, which guarantees that respondents in all groups are primed on the issue of interest (Haaland et al., 2023). This approach does not introduce any differential attrition across groups (Appendix Section C).

In addition, because outcomes of interest include behavioral measures collected in the period after the delivery of interventions (see Section 3.2), we reinforced the content of each module with text messages sent to participants' mobile phones 10 weeks after the delivery of interventions. Text messages were also implemented cumulatively. Because text messages were not designed to allow for interaction with the participant, the text message sent to T3 summarizes the concluding statement of the *inoculation* module. The specific phrasing of text messages is provided in Appendices A1–A3.

3.2 | Sampling and data collection

We contacted a sample of 2916 respondents from two previous projects implemented in the Greater Maputo area (1509 respondents) and in the Cabo Delgado province (1407 respondents). The Greater Maputo area is composed of Maputo City, the capital of Mozambique and home to a population of 1.1 million, and the surrounding Maputo Province, home to a population of 2.3 million (INE, 2021). In August 2021, Maputo City had the highest number of cumulative COVID-19 cases (4693.74 per 100,000 inhabitants) and the highest corresponding mortality rate (2.03%, out of all the cases) in the country (Ministry of Health of Mozambique, 2021a). The Cabo Delgado province is the northernmost province of Mozambique, home to a population of 2.6 million (INE, 2021). This primarily rural province had, over the same period, a lower number of COVID-19 cases (142.47 per 100,000 inhabitants) and mortality rate (0.33%) (Ministry of Health of Mozambique, 2021a). The province presented extraordinary challenges due to the conflict situation initiated in October 2017, when insurgents started perpetrating violent attacks on civilians and military alike (Armand et al., 2020).

The *Maputo sample* was composed of micro-entrepreneurs in the markets of the Greater Maputo area who participated in the baseline survey of Batista et al. (2022). These micro-entrepreneurs had been selected by in-field random sampling in 23 urban and peri-urban markets in Maputo and its satellite city, Matola. Stratification was based on the gender of the respondent and the type of establishment (stall vs. store). The *Cabo Delgado* sample was composed of household heads who participated in the baseline survey of Armand et al. (2020). These household heads were chosen to represent 206 communities in Cabo Delgado, randomly drawn from the list of all 421 polling locations in the sampling frame, stratified on urban, semi-urban, and rural areas.[8]

For data collection, we set up two phone survey teams with the ability to speak in local languages, one in Maputo and one in Pemba, the capital of the Cabo Delgado province. Appendix Figure A1 presents the data collection timeline, superimposed on the rolling 7-day average of daily COVID-19 cases over the entire duration of the study, while Section 3.2 describes the content of survey instruments.

We conducted a baseline survey between October 30 and November 30, 2020, interviewing a total of 862 respondents (554 in Maputo and 308 in Cabo Delgado). The baseline survey questionnaire includes detailed questions about the respondents' economic status, behaviors over the past 7 days, attitudes toward a future vaccine, and perceptions about the government's response to the pandemic.[9]

The endline survey was implemented between February 18 and March 6, 2021, interviewing a total of 712 respondents (448 in Maputo and 264 in Cabo Delgado). As compared to the baseline survey questionnaire, the endline questionnaire keeps some of the questions about the respondents' economic status, most of those related to behaviors over the past seven days and to perceptions about the government's response, expanded the section on attitudes toward COVID-19 vaccines, added new questions on trust in institutions, and several questions to account for the potential presence of social desirability bias.

To minimize attrition, in both the baseline and endline surveys, we completed up to two attempts to contact each phone number on separate days. All respondents received a token of appreciation of 100 Meticais in airtime (around US$ 1.6 as of June 2021). Appendix C analyzes attrition from baseline to endline, showing that selective attrition across treatment groups is unlikely.

Survey measures are supplemented with behavioral measures based on SMSs. After the endline survey, we sent respondents three different invitations through text messages using the contact numbers provided by the respondents. For each invitation, we activated a dedicated phone number, which remained active for the whole duration of the service. The first invitation offered a subscription to a free SMS information service providing regular updates on COVID-19 vaccination in Mozambique. Respondents had to reply "Yes" to subscribe to the service. The second invitation asked recipients to send anonymous feedback to the Ministry of Health on its performance handling the pandemic. The third invitation asked recipients to report a specific rumor about COVID-19 for fact-checking. Additionally, they could flag a phone number to which they wanted us to send the fact-checked information.[10] Following the invitations, we sent weekly reminders until the moment of subscription (in the case of the first invitation) or until the moment the SMS services were terminated (11 weeks after the completion of the endline survey).

Behavioral text messages involve costly actions, which are less likely to be prone to desirability biases as compared to survey questions.[11] In addition, because survey data capture outcomes at the time of interventions, we also rely on behavioral text messages to measure behavior in the post-intervention period.

3.3 | Randomization

We implemented the interventions discussed in Section 3.1 during the endline phone survey. To create exogenous variation in the exposure to each intervention, we randomly allocated each respondent of the baseline survey to one of the four groups (C, T1, T2, or T3). We follow individual-level randomization stratifying on the region of residence (Maputo and Cabo Delgado), age group (under 40, between 40 and 50, between 50 and 60, over 60), and gender. Because the interventions are delivered by the enumerators, we also randomly assign respondents to enumerators while accounting for the enumerators' province of residence and language spoken. Figure C1 summarizes the experimental design in a CONSORT diagram, including the allocation of participants to each treatment group.[12]

Table C1 provides an overall description of respondents' characteristics by looking at the mean of the pure control group. Forty percent of our respondents are female, the average age of the respondents is 46 years, and the average household size is 5 members. Seventeen percent have completed at least 12 years of schooling. Turning to religion, 37% are Protestant, 29% are Catholic, and 24% are Muslim. The total individual income over the week previous to the interview was 2933.99 Meticais (US$ 46.51 as of June 2021).

Appendix C presents balance tests on baseline characteristics for all respondents across the three treatment arms when compared to the pure control group. Simple mean comparisons are supplemented with a joint F-test to jointly verify balance across all variables. We run 24 tests and find no statistical significance.

4 | ESTIMATION STRATEGY

Because the randomization procedure was able to identify comparable groups, namely in terms of the demographic characteristics of the respondents, we can estimate impacts using follow-up comparisons of outcomes. To estimate treatment effects, we first consider the following specification:

$$y_i = \alpha + \beta_1 \mathrm{T1}_i + \beta_2 \mathrm{T2}_i + \beta_3 \mathrm{T3}_i + X_i'\gamma + \epsilon_{ib} \tag{1}$$

where y_i is the outcome of interest, and it is assumed that higher values of y_i signify better outcomes. Treatment indicators are binary variables taking value 1 if the respondent is assigned to the corresponding treatment group and 0 otherwise. X_i is a set of controls, including the strata indicators used for randomization (see Section 3.3) and enumerator fixed effects. Finally, ϵ_i is an idiosyncratic error term assumed to be clustered at the level of the enumeration area in the original sample.

When the baseline values of the outcome variables are available, we employ the following ANCOVA specification:

$$y_i = \alpha + \beta_1 \mathrm{T1}_i + \beta_2 \mathrm{T2}_i + \beta_3 \mathrm{T3}_i + X_i'\gamma + \delta y_{i0} + \epsilon_{ib} \tag{2}$$

where y_{i0} is the baseline value of the dependent variable. When the outcome variable has a low serial auto-correlation, which is the case for many of our survey outcomes, controlling for the baseline value of the dependent variable maximizes statistical power (McKenzie, 2012). Section 5 presents estimates of treatment effects using either Equation (1) or Equation (2), depending on the availability of baseline data. In addition, because the duration of the endline survey is closely related to the delivery of interventions, Appendix D2, including Tables D3-D6, provides estimates of treatment effects accounting for the duration of the endline survey. Results are robust to conditioning on the duration of the endline survey.

5 | RESULTS

The following sections discuss the treatment effects of each intervention on different sets of outcomes. Section 5.1 focuses on vaccine acceptance, while Section 5.2 reports results on trust in institutions. Section 5.3 addresses potential issues related to social desirability bias, including a discussion of treatment effects on behavioral outcomes. Finally, Section 5.4 presents treatment effects on outcome variables aggregated into indices.

5.1 | Vaccine acceptance

Table 1 shows estimates of treatment effects on the acceptance of the COVID-19 vaccines. We find a positive treatment effect of T3 on the direct indicator of acceptance. This intervention increases the willingness to take a COVID-19 vaccine in the future

TABLE 1 Acceptance of COVID-19 vaccines.

			COVID-19 vaccines are…				
	Willingness to take vaccine (1)	**Would be among the first to take (2)**	**Effective (3)**	**Safe (4)**	**Without side effects (5)**	**Why take: protect myself (6)**	**Why not take side effects (7)**
T1	−0.011	0.024	0.151	0.096	0.159	0.025	0.004
	(0.026)	(0.042)	(0.093)	(0.098)	(0.104)	(0.035)	(0.022)
T2	0.052	0.046	0.249***	0.144	0.045	0.063*	−0.019
	(0.033)	(0.050)	(0.095)	(0.105)	(0.096)	(0.034)	(0.027)
T3	0.059**	0.109***	0.260**	0.379***	0.304***	0.043	−0.040*
	(0.029)	(0.041)	(0.101)	(0.097)	(0.103)	(0.040)	(0.024)
N	698	691	685	683	688	698	698
Mean dep. Variable (control)	0.870	0.645	3.418	3.315	2.960	0.778	0.070
Baseline	YES	NO	NO	NO	NO	YES	YES
R^2	0.102	0.164	0.107	0.116	0.156	0.100	0.059
Equality of treatment effects (*p-values*)							
T1 = T2	0.051	0.565	0.259	0.632	0.259	0.186	0.378
T1 = T3	0.008	0.056	0.225	0.000	0.151	0.622	0.063
T2 = T3	0.850	0.243	0.907	0.020	0.023	0.582	0.389
T1 = T2 = T3 = 0	0.020	0.052	0.031	0.000	0.031	0.264	0.254

Note: Estimates based on OLS regressions. Columns (2)–(5) present estimates using Equation (1), columns (1), (6), and (7) present estimates using Equation (2). Depending on the column, the dependent variables are defined by the following. (1): indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'When a COVID-19 vaccine becomes available in the future, would you take it?', and 0 otherwise. (2): indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'Would you like to be among the first ones to get vaccinated against COVID-19 when the vaccine becomes available?', and 0 otherwise. (3)–(5): variables using a 5-item Likert scale that takes the values 1 'Strongly disagree,' 2 'Disagree,' 3 'Neither agree nor disagree,' 4 'Agree,' and 5 'Strongly agree' to measure agreement with the following statements: (3) 'The COVID-19 vaccines currently produced are effective in preventing the disease;' (4) 'The COVID-19 vaccines currently produced are safe;' (5) 'The vaccines against COVID-19 currently produced might bring some serious side effects' [Reversed]. (6): indicator variable that takes value 1 if respondent chose 'I want to protect myself from having COVID-19 in the future' in response to the question: 'Why would you take it?' - conditional on having answered 'Yes' to the question in (1), and 0 otherwise. (7): indicator variable that takes value 1 if respondent chose 'I would be concerned about possibility that the side effects from the vaccine are harmful' in response to the question: 'Why would you not take it?', and 0 otherwise. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

by 6% points, significant at the 5% level (column 1). The estimates of the effect of T2 and T3 are statistically different from the ones of T1, but they cannot be distinguished from one another. In line with this result, T3 also increases the respondents' willingness to be among the first to take the vaccine (column 2). The magnitude of this effect is 11% points and significant at the 1% level. For this outcome, the estimate of the effect of T3 is statistically different from the one of T1, but it is not statistically different from the effect of T2. These effects add up to the increase in the stated willingness to take the vaccine observed from baseline to endline. In this period, the stated willingness in the control group increased from 74 to 87% (Appendix Figure A2).

Turning to beliefs about the COVID-19 vaccine, column (3) shows that T2 and T3 increase their perceived effectiveness by 7 and 8%, significant at the 1 and 5% levels of statistical confidence, respectively. T3 also increases respondents' perceived safety by 11%, significant at the 1% level (column 4). Note that this effect is significantly different from both T1 and T2, which isolates the specific importance of T3. Consistently, T3 leads to a 10% increase in the belief that COVID-19 vaccines do not have side effects, significant at the 1% level (column 5). Columns (6) and (7) report treatment effects on the most frequently cited reasons for taking or not taking the vaccine, respectively. We observe that T2 increases by 6% points the likelihood of reporting '*protecting myself*' as a reason to take the vaccine (significant at the 10% level), while T3 reduces by 4% points the likelihood of reporting '*side effects*' as a reason for not taking the vaccine.

We conclude that T3 is particularly effective at increasing the stated acceptance of the COVID-19 vaccine. Moreover, both T2 and T3 are effective at improving the perceptions about vaccine effectiveness and safety. We do not find significant effects of T1. Overall, there seems to be an important role of the inoculation module for these outcomes.

5.2 | Trust in institutions

Table 2 reports estimates of treatment effects on measures capturing the level of trust in institutions among the study participants. We find that T1 and T3 increase the perception that the government decides on COVID-19 vaccine provision in the population's best interest (column 1). The magnitudes of these effects are 5 and 7%, significant at the 5 and 1% levels of statistical confidence, respectively. The effect of T3 is significantly different from the effect of T2. Both T2 and T3 have positive effects on the belief that the government is purchasing high-quality vaccines by 7 and 6%, respectively (column 2). Consistently, we observe that T3 has a positive impact on the perception that the government is reacting appropriately to the crisis, with an effect size of 8% points, significant at the 10% level (column 3).

Closely related to the level of trust in institutions is public corruption, which has been shown to decrease the immunization progress in the COVID-19 vaccination campaigns (Farzanegan & Hofmann, 2021). In column 4, we estimate the treatment effect on the general perceptions of corruption. We observe that T3 reduces the perceived level of corruption of the local government by 10%, significant at the 10% level and significantly different from the effect of T2. Concerning the willingness to visit a health facility in case of infection with COVID-19 (column 5), the three treatments increase the reported intention to visit by 3–4% points, with statistical significance ranging between 5 and 10%. We do not find any significant treatment effect on measures of perceived support of COVID-19 vaccines among the local leaders and the local community (columns 6 and 7), as expected, given individual-level treatment and the short lag between the interventions and measurement.

Overall, we find positive impacts of all interventions on trusting governmental institutions, especially in how they handle the COVID-19 pandemic and the corresponding vaccination process. Differences between treatments are not as clear as for vaccine acceptance, which is suggestive of a prominent role of the basic endorsement message in affecting participants' trust in institutions. These effects reinforce the close link between trust in institutions and vaccine acceptance. We observe that higher trust in institutions at baseline positively correlates with measures of vaccine acceptance at both baseline and endline, including willingness to take the COVID-19 vaccine, being among the first to vaccinate, and believing that COVID-19 vaccines are effective and safe (Appendix D3).

5.3 | Social desirability and behavioral outcomes

Table 3 investigates the potential presence of social desirability bias in our treatment effects as measured through survey questions. While this is a common risk associated with survey measures and, in particular, experiments implemented in the context of surveys, we do not observe any consistent effect using the Socially Desirable Response Set Five-Item Survey (SDRS-5) (Hays et al., 1989). The index aggregates answers to questions about whether survey respondents take socially inappropriate behaviors. If anything, we find that T2 has a negative effect of 4% points, significant at the 10% level, which goes in the opposite direction of social desirability. We also do not observe any significant effect on reported engagement in recommended

TABLE 2 Trust in institutions.

	On vaccines, the government ..						
	Decides in population's best interest (1)	**Purchases highest quality (2)**	**Appropriate COVID-19 reaction (3)**	**Local government not involved in corruption (4)**	**Willingness to visit health facility if infected (5)**	**Leaders support vaccines (6)**	**Community willing to take the vaccine (7)**
T1	0.202**	0.111	0.003	0.218	0.037*	0.016	0.002
	(0.078)	(0.088)	(0.042)	(0.139)	(0.020)	(0.075)	(0.088)
T2	0.119	0.221**	0.035	−0.041	0.038**	0.023	0.118
	(0.079)	(0.100)	(0.041)	(0.115)	(0.017)	(0.087)	(0.074)
T3	0.258***	0.198**	0.079*	0.242*	0.031*	0.042	0.013
	(0.083)	(0.100)	(0.046)	(0.132)	(0.019)	(0.106)	(0.082)
N	692	687	680	631	710	681	695
Mean dep. Variable (control)	3.606	3.306	0.628	2.494	0.946	3.578	3.547
Baseline	NO	NO	YES	NO	YES	NO	NO
R^2	0.237	0.161	0.195	0.120	0.076	0.067	0.095
Equality of treatment effects (*p-values*)							
T1 = T2	0.373	0.320	0.430	0.054	0.972	0.935	0.138
T1 = T3	0.467	0.311	0.126	0.858	0.707	0.798	0.902
T2 = T3	0.090	0.820	0.312	0.017	0.696	0.855	0.158
T1 = T2 = T3 = 0	0.015	0.124	0.347	0.064	0.150	0.982	0.252

Note: Estimates based on OLS regressions. Columns (1), (2), (4), (6) and (7) present estimates using Equation (1), columns (3), (5) present estimates using Equation (2). Depending on the column the dependent variables are defined by the following. (1), (2), (4), (6) and (7): variables using a 5-item Likert scale that takes the values 1 'Strongly disagree,' 2 'Disagree,' 3 'Neither agree nor disagree,' 4 'Agree,' 5 'Strongly agree' to measure agreement with the following statements: (1) 'The national government is making decisions in your best interest with respect to which COVID-19 vaccines are provided;' (2) 'The national government purchases the highest quality COVID-19 vaccines available;' (4) 'Agents of your local government (provincial, district, or municipal) are involved in corruption'; (6) 'Leaders (religious, political, teachers, health care workers) in your community support the COVID-19 vaccines currently produced;' (7) 'People in your community/circle of friends are willing to take the COVID-19 vaccine'. (3): indicator variable that takes value 1 if respondent answered 'The reaction is appropriate' to the question: 'What do you think about the reaction of your country's government to the current COVID-19 outbreak?' (answers available: 1 'The reaction is very exaggerated,' 2 'The reaction is exaggerated,' 3 'The reaction is appropriate,' 4 'The reaction is insufficient,' 5 'The reaction is very insufficient'), and 0 otherwise. (5): indicator variable that takes value 1 if respondent chose a health facility in response to the question: 'If you thought you had COVID-19, where would you seek treatment?', and 0 otherwise. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

preventive behaviors over the past week or past reported behaviors and intentions related to the polio vaccination. Treatment effects on reported past behaviors would be particularly worrying with regard to social desirability. While we do not identify any clear reasons for concern, we supplement results with an analysis of outcomes related to the behavioral text messages we implemented (see Section 3.2). As discussed above, the outcome variables based on these SMS services are likely to be less prone to social desirability when compared to survey measures. In Table 4 we analyze treatment effects on behavioral outcomes estimated using Equation (1). This is because these measures are available only after the follow-up survey. We focus on whether participants subscribed to the service providing information related to COVID-19 vaccination, provided feedback to the Ministry of Health on the management of the pandemic situation, and/or requested fact-checking on rumors related to COVID-19.

We do not observe any significant treatment effect on subscribing to the information service (column 1). Differently, T1 increases by 0.16 the number of feedback messages sent by respondents to the Ministry of Health (column 2). This effect is statistically significant at the 5% level. We do not observe any significant impact on the total number of messages asking to debunk fake news to specific phone numbers (column 3). There are no significant differences between treatment effects in any of the three behavioral measures.

No systematic treatment effects emerge when employing behavioral measures. T1 seems to be particularly influential in incentivizing interaction with the Ministry of Health, which could be interpreted as T1 inducing higher trust in institutions, consistent with some of the results in Table 2.

TABLE 3 Social desirability.

	Social desirability index (1)	Went to market (frequency) (2)	Went to Church or mosque (3)	Washed hands more often (4)	Used face mask (5)	Household member received polio vaccine (6)	Willingness to vaccinate newborn against polio (7)
T1	−0.002	0.006	0.002	0.010	−0.001	−0.005	−0.031
	(0.018)	(0.155)	(0.026)	(0.031)	(0.008)	(0.031)	(0.021)
T2	−0.035*	−0.003	−0.008	−0.015	−0.007	0.011	−0.007
	(0.019)	(0.132)	(0.030)	(0.034)	(0.010)	(0.026)	(0.019)
T3	−0.016	0.171	−0.035	−0.014	−0.002	0.002	−0.007
	(0.018)	(0.135)	(0.031)	(0.039)	(0.009)	(0.029)	(0.019)
N	705	699	709	708	709	478	685
Mean dep. Variable (control)	0.114	3.098	0.118	0.887	0.995	0.949	0.967
Baseline	NO	YES	YES	YES	YES	NO	NO
R^2	0.290	0.082	0.149	0.094	0.030	0.064	0.114
Equality of treatment effects (*p-values*)							
T1 = T2	0.106	0.956	0.725	0.425	0.452	0.613	0.239
T1 = T3	0.446	0.277	0.215	0.428	0.883	0.837	0.240
T2 = T3	0.246	0.298	0.380	0.989	0.563	0.712	0.979
T1 = T2 = T3 = 0	0.286	0.570	0.622	0.832	0.875	0.957	0.477

Note: Estimates based on OLS regressions. Columns (1), (6), and (7) present estimates using Equation (1), columns (2), (3), (4), and (5) present estimates using Equation (2), which includes the lagged dependent variable (ANCOVA). Depending on the column the dependent variables are defined by the following. (1): index of equally weighted variables recording as 1 the most extreme positive answer to the scale 1 'Definitely false,' 2 'False,' 3 'Don't know,' 4 'True,' 5 'Definitely true' in response to the following statements: 'I am always courteous even to people who are disagreeable;' 'There have been occasions when I took advantage of someone' [Reversed]; 'I sometimes try to get even rather than forgive and forget' [Reversed]; 'I sometimes feel resentful when I don't get my way' [Reversed]; 'No matter who I'm talking to, I'm always a good listener.' (2): variable that takes the values 1 'Never (0 days),' 2 'Once (1 day),' 3 'Some days (2–3 days),' 4 'Most days (4–6 days),' 5 'Every day (7 days)' in response to the question: 'In the past 7 days, how often did members of your household go to a market or food store?' (3): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'In the past 7 days, have you attended Church or mosque, or gathered with people from outside your household to pray?', and 0 otherwise. (4): indicator variable that takes value 1 if respondent answered 'More' to the question: 'In the past 7 days, have you washed your hands with soap and water more often, less often, or about the same as you did before the government closed schools?' (answers available: 'Less,' 'Same,' 'More,' 'Don't know'), and 0 otherwise. (5): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'In the last 7 days have you always worn a face mask or other nose/mouth covering when going out in public?', and 0 otherwise. (6): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'Has any member of your household ever received any vaccination drops in the mouth to protect (him/her) from polio?', and 0 otherwise. (7): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'If you had a newborn in the household would you want to vaccinate him/her against polio?', and 0 otherwise. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

5.4 | Treatment effects on aggregated outcomes

In order to address potential concerns related to the testing of multiple hypotheses, we aggregate the main outcome variables presented in Tables 1–4 into indices using the procedure of Kling et al. (2007). We calculate within-sample z-scores for each individual outcome employing the mean and the standard deviation of the pure control group. We then obtain the unweighted average z-score for the relevant set of outcomes presented in each table. We consider the following indices: vaccine acceptance (outcomes in columns 1–5 of Table 1), trust in institutions (outcomes in columns 1–5 of Table 2), desirability bias (all outcomes of 3), and behavioral measures (all outcomes of 4).

Figure 1 summarizes estimates of treatment effect on these indices (Appendix D1 provides further details about estimates). We find significant treatment effects of T2 and T3 on vaccine acceptance. In particular, the effect of T3 is significantly different from that of T1 and T2, at the one and five percent levels, respectively. This suggests a clear impact of the social memory and the inoculation modules, and a significant additional effect of the latter. All treatments are effective at increasing trust in institutions, with the effect of T3 significantly different from that of T2 at the 10 percent level. Social desirability is not statistically different from the control group for each of the treatment groups, reinforcing that a bias is not present in our survey measures. Finally, we do not find any significant treatment effects on behavioral measures.

TABLE 4 Behavioral measures based on SMS services.

	Subscribed to information service on COVID-19 (1)	Total number of text messages to Ministry of Health (2)	Total number of text messages to debunk fake news (3)
T1	−0.034	0.157**	0.034
	(0.049)	(0.079)	(0.075)
T2	0.005	0.130	0.072
	(0.048)	(0.081)	(0.092)
T3	−0.062	0.058	0.107
	(0.055)	(0.078)	(0.079)
N	698	698	698
Mean dep. Variable (control)	0.495	0.288	0.234
Baseline	NO	NO	NO
R^2	0.066	0.044	0.047
Equality of treatment effects (*p-values*)			
T1 = T2	0.433	0.760	0.697
T1 = T3	0.532	0.229	0.342
T2 = T3	0.136	0.385	0.742
T1 = T2 = T3 = 0	0.501	0.184	0.536

Note: Estimates based on OLS regressions. Columns (1)–(4) present estimates using Equation (1). (1): indicator variable that takes value 1 if respondent answered 'Yes' to the invitation to subscribe to the COVID-19 vaccine information service, and 0 otherwise. (2): total number of text messages received in response to the invitation to send feedback to the Ministry of Health on its management of the pandemic situation. (3): total number of text messages received in response to the invitation to send unverified information to be debunked to specific phone numbers. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

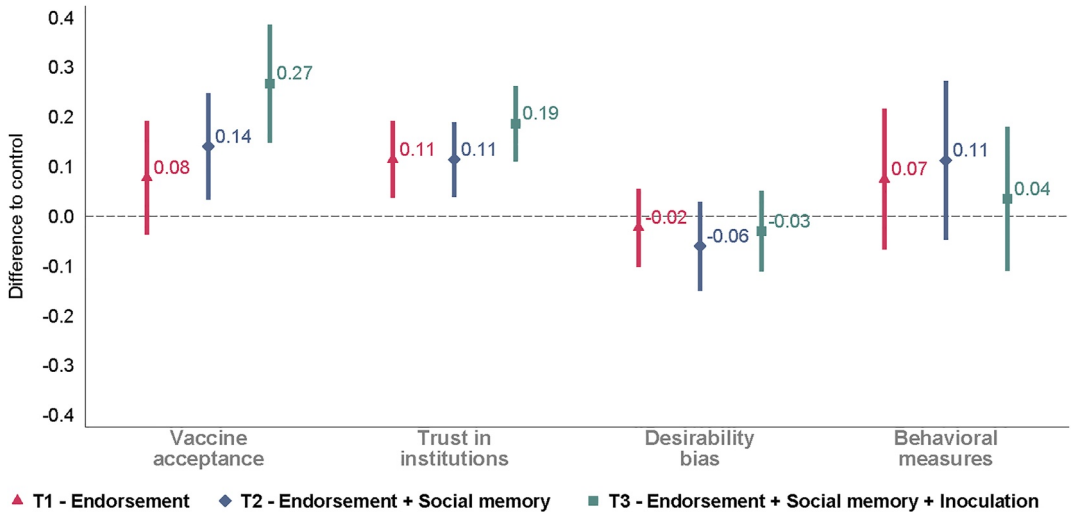

FIGURE 1 Treatment effects on aggregated outcomes. Estimates based on OLS regressions using Equation (1). The coefficients are presented in Section D1. Outcomes are grouped in indices that are built using the procedure in Kling et al. (2007). The procedure is detailed in Section 5.4. The indices represent the following outcomes: (1) Vaccine acceptance includes the outcomes in columns (1)-(5) of Table 1; (2) Trust in institutions includes the outcomes in columns (1)-(5) of Table 2; (3) Desirability bias includes the outcomes of Table 3; (4) Behavioral measures includes the outcomes of Table 4. The full list of controls is presented in Section 4. Confidence intervals are built using statistical significance at the 10 percent level. Standard errors are clustered at the enumeration area level.

Appendix D1 provides estimates of heterogeneous treatment effects. We find no systematic differences in our treatment effects on acceptance of the COVID-19 vaccine, trusting institutions, and behavioral measures when interacting them with characteristics of our sample, such as gender, age, and indicators for the sub-sample (Maputo or Cabo Delgado). There are, however, some relevant exceptions. The Cabo Delgado sub-sample reacts less positively to T3 in all survey measures and to T2 in measures of trust in institutions. T1 elicits less positive reactions in behavioral measures among younger respondents and in trust in institutions among female respondents.

6 | CONCLUSION

In this paper, we test the effectiveness of information-provision interventions aimed at increasing vaccine acceptance. In the context of Mozambique, we find that combining an endorsement of vaccines, a reminder about a successful immunization campaign, and a structured interaction with participants inoculating against fake news about vaccination was successful at increasing both vaccine acceptance and trust in institutions. These effects are not driven by social desirability.

While this study focuses on promoting vaccine acceptance in low- and middle-income countries, the findings have broader implications for all kinds of information campaigns aimed at stimulating behavioral change. One key takeaway is that one-to-one information campaigns using phone conversations can be an effective way to stimulate both the targeted behavior and trust in institutions. Additionally, combining the provision of passive information with alternative methods that stimulate social memory and inoculate against misleading information could further improve the effectiveness of information campaigns.

We find that combining alternative forms of information campaigns is not only effective in increasing vaccine acceptance but also cost-effective (Appendix Section D4, Table D8). We estimate that providing a simple endorsement module costs 4.4 USD per person, while combining the endorsement, social memory, and inoculation module costs 7.3 USD per person. As a result, in our setting, raising vaccine acceptance by 1 standard deviation has a per capita cost of 6.5 USD. These results confirm the cost-effectiveness of phone-based interventions targeting health outcomes in a variety of settings, including mHealth (Iribarren et al., 2017), mental health (Goldberg et al., 2022), and vaccination uptake (Oliver-Williams et al., 2017).

Overall, this study highlights the importance of using a multifaceted approach to information campaigns that take into account people's trust in institutions and the circulation of misinformation. Further research is needed to explore how different combinations of interventions can further improve the effectiveness of information campaigns in achieving the targeted outcome.

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CONFLICT OF INTEREST STATEMENT

Dr. Armand has nothing to disclose.

DATA AVAILABILITY STATEMENT

The data and replication package will be made available upon publication.

ORCID

Pedro C. Vicente https://orcid.org/0000-0002-9864-5012

ENDNOTES

[1] Section 2 provides detailed information about the timing of the interventions relative to vaccine availability in Mozambique.

[2] A related literature highlights how including behavioral nudges in information campaigns can also stimulate preventive health behaviors (Bonander et al., 2022; Dai et al., 2021; Duarte, 2023; Sasaki et al., 2022).

[3] High acceptance and take-up of traditional vaccines for children might not translate into high take-up rates of a novel vaccine for adults. We discuss acceptance of COVID-19 vaccines in our sample in Section 5.1.

[4] Section 3.3 provides more details about the study timeline. The other vaccines were approved either during or after the completion of interventions, such as SII/COVISHIELD and AstraZeneca/AZD1222 (February 16th, 2021), Janssen/Ad26.COV 2.S (March 12th, 2021), and Moderna mRNA 1273 (April 30th, 2021).

[5] A new case of wild polio was recently recorded in Mozambique in 2022 (WHO, 2021c).

[6] An example is the award-winning online game Bad News. The game offers a simulated social media environment in which people take on the role of a fake news creator and learn about standard misinformation techniques. Exposure to these processes in the game facilitates resistance to misleading information (Basol et al., 2020).

[7] These interventions aim at increasing vaccine acceptance. More standard approaches in vaccination campaigns are instead aiming at increasing vaccination rates directly by calling recipients and scheduling vaccination appointments (see, e.g., Batteux et al., 2022). Our approach is, therefore, indirectly targeting vaccination rates.

[8] Batista et al. (2022) evaluate the impact of business training vis-à-vis a mobile savings intervention on micro-entrepreneurs business outcomes. The baseline was conducted between October 2013 and April 2014, with the main follow-up survey implemented in July–November 2015. Armand et al. (2020) test whether community information can counteract the potential rise of a political resource curse after a substantial natural gas discovery. The baseline survey was conducted in August–September 2016, and the follow-up in August–September 2017. For both samples, we considered only respondents with at least one contact phone number recorded. These represent 95.6% of the respondents in the sample of Batista et al. (2022), and 61.7% in the sample of Armand et al. (2020).

[9] In the questionnaire, we refer to a "COVID-19 vaccine" without specifying the producer.

[10] Appendices B1–B3 provide more details about the invitations, including the exact scripts.

[11] In Mozambique, similar measures were used in the context of voter education (Aker et al., 2017) and mobilization (Grácio & Vicente, 2021).

[12] Appendix D5, Table D9, provides power calculations for our experimental design. This design allows identifying a (standardized) minimum detectable effect of 0.09–0.1 standard deviations (ex-post, one-sided).

REFERENCES

Agosti, F., Toffolutti, V., Cavalli, N., Nivakoski, S., Mascherini, M., & Aassve, A. (2022). Information and vaccine hesitancy: Evidence from the early stage of the vaccine roll-out in 28 European countries. *PLoS One*, *17*(9), e0273555. https://doi.org/10.1371/journal.pone.0273555

Aker, J. C., Collier, P., & Vicente, P. C. (2017). Is information power? Using mobile phones and free newspapers during an election in Mozambique. *The Review of Economics and Statistics*, *99*(2), 185–200. https://doi.org/10.1162/rest_a_00611

Alsan, M., & Eichmeyer, S. (2021). Experimental evidence on the effectiveness of non-experts for improving vaccine demand. NBER Working Paper No. 28593.

Alsan, M., Stanford, F. C., Banerjee, A., Breza, E., Chandrasekhar, A. G., & Eichmeyer, S. (2021). Comparison of knowledge and information-seeking behavior after general COVID-19 public health messages and messages tailored for black and latinx communities: A randomized controlled trial. *Annals of Internal Medicine*, *174*(4), 484–492. https://doi.org/10.7326/m20-6141

Alsan, M., & Wanamaker, M. (2018). Tuskegee and the health of black men. *Quarterly Journal of Economics*, *133*(1), 407–455. https://doi.org/10.1093/qje/qjx029

Armand, A., Alexander, C., Vicente, P. C., & Inês, V. (2020). Does information break the political resource curse? Experimental evidence from Mozambique. *The American Economic Review*, *110*(11), 3431–3453. https://doi.org/10.1257/aer.20190842

Armand, A., Augsburg, B., & Bancalari, A. (2022). Social proximity and misinformation: Experimental evidence from a mobile phone-based campaign in India. CEPR Discussion Paper DP16492.

Armand, A., Mattia, F., and Vicente, P. C. 2021. "COVID-19 vaccine acceptability in Mozambique." American economic association RCT registry. https://doi.org/10.1257/rct.7228-1.0

Banas, J. A., & Rains, S. A. (2010). A meta-analysis of research on inoculation theory. *Communication Monographs*, *77*(3), 281–311. https://doi.org/10.1080/03637751003758193

Banerjee, A., Alsan, M., Breza, E., Chandrasekhar, A. G., Chowdhury, A., Duflo, E., … & Olken, B. A. 2020. "Messages on covid-19 prevention in India increased symptoms reporting and adherence to preventive behaviors among 25 million recipients with similar effects on non-recipient members of their communities." NBER Working Paper No. 27496.

Barrera, O., Guriev, S., Henry, E., & Zhuravskaya, E. (2020). Facts, alternative facts, and fact checking in times of post-truth politics. *Journal of Public Economics*, *182*, 104123. https://doi.org/10.1016/j.jpubeco.2019.104123

Basol, M., Roozenbeek, J., & Van der Linden, S. (2020). Good news about Bad news: Gamified inoculation boosts confidence and cognitive immunity against fake news. *Journal of Cognition*, *3*(1), 2. https://doi.org/10.5334/joc.91

Batista, C., Sequeira, S., & Vicente, P. C. (2022). Closing the gender profit gap? *Management Science*, *68*(12), 8553–8567. https://doi.org/10.2139/ssrn.4114318

Batteux, E., Mills, F., Jones, L. F., Symons, C., & Weston, D. (2022). The effectiveness of interventions for increasing COVID-19 vaccine uptake: A systematic review. *Vaccines*, *10*(3), 386. https://doi.org/10.3390/vaccines10030386

Bonander, C., Ekman, M., & Jakobsson, N. (2022). Vaccination nudges: A study of pre-booked COVID-19 vaccinations in Sweden. *Social Science & Medicine*, *309*, 115248. https://doi.org/10.1016/j.socscimed.2022.115248

Brady, W. J., Wills, J. A., Jost, J. T., Tucker, J. A., & Van Bavel, J. J. (2017). Emotion shapes the diffusion of moralized content in social networks. *Proceedings of the National Academy of Sciences*, *114*(28), 7313–7318. https://doi.org/10.1073/pnas.1618923114

Bursztyn, L., Rao, A., Roth, C. P., & Yanagizawa-Drott, D. H. (2023). Opinions as facts. *The Review of Economic Studies*, *90*(4), 1832–1864. https://doi.org/10.1093/restud/rdac065

Carey, J. M., Chi, V., Flynn, D. J., Nyhan, B., & Zeitzoff, T. (2020). The effects of corrective information about disease epidemics and outbreaks: Evidence from zika and yellow fever in Brazil. *Science Advances*, *6*(5), eaaw7449. https://doi.org/10.1126/sciadv.aaw7449

Cassocera, M., Chissaque, A., Martins, M., & de Deus, N. (2020). *40 years of immunization in Mozambique: A narrative review of literature, accomplishments, and perspective*. In *s* (Vol. 36). Cadernos de Saúde Pública.

Compton, J. (2013). Inoculation theory. *The SAGE Handbook of Persuasion: Developments in Theory and Practice*, *2*, 220–237.

Compton, J., Jackson, B., & Dimmock, J. A. (2016). Persuading others to avoid persuasion: Inoculation theory and resistant health attitudes. *Frontiers in Psychology*, *7*, 122. https://doi.org/10.3389/fpsyg.2016.00122

Compton, J., van der Linden, S., Cook, J., & Basol, M. (2021). Inoculation theory in the post-truth era: Extant findings and new frontiers for contested science, misinformation, and conspiracy theories. *Social and Personality Psychology Compass*, *15*(6), e12602. https://doi.org/10.1111/spc3.12602

Cook, J., Lewandowsky, S., & Ullrich, K. (2017). Neutralizing misinformation through inoculation: Exposing misleading argumentation techniques reduces their influence. *PLoS One*, *12*(5), e0175799. https://doi.org/10.1371/journal.pone.0175799

Cordoba-Sanchez, V., Lemos, M., Alfredo Tamayo-Lopera, D., & Sheinfeld Gorin, S. (2022). HPV-vaccine hesitancy in Colombia: A mixed-methods study. *Vaccines*, *10*(8), 1187. https://doi.org/10.3390/vaccines10081187

Dai, H., Saccardo, S., Han, M. A., Roh, L., Raja, N., Vangala, S., Modi, H., Pandya, S., Sloyan, M., & Croymans, D. M. (2021). Behavioural nudges increase COVID-19 vaccinations. *Nature*, *597*(7876), 404–409. https://doi.org/10.1038/s41586-021-03843-2

Dhaliwal, I., Duflo, E., Glennerster, R., & Tulloch, C. (2013). Comparative cost-effectiveness analysis to inform policy in developing countries: A general framework with applications for education. *Education Policy in Developing Countries*, *17*, 285–338.

Duarte, J. P. (2023). *Encouraging completion of HPV vaccine schedule using decision aids*. Ph.D. thesis, Universidad del Rosario Bogotá.

Dupas, P. (2011). Health behavior in developing countries. *Annual Review of Economics*, *3*(1), 425–449. https://doi.org/10.1146/annurev-economics-111809-125029

Ecker, U. K. H., Lewandowsky, S., & Tang, D. (2010). Explicit warnings reduce but do not eliminate the continued influence of misinformation. *Memory & Cognition*, *38*(8), 1087–1100. https://doi.org/10.3758/mc.38.8.1087

Egger, D., Miguel, E., Warren, S. S., Shenoy, A., Collins, E., Dean, K., Parkerson, D., Mobarak, A. M., Fink, G., Udry, C., Walker, M., Haushofer, J., Larreboure, M., Athey, S., Lopez-Pena, P., Benhachmi, S., Humphreys, M., Lowe, L., Meriggi, N. F., & Vernot, C. (2021). Falling living standards during the COVID-19 crisis: Quantitative evidence from nine developing countries. *Science Advances*, *7*(6). https://doi.org/10.1126/sciadv.abe0997

Farzanegan, M. R., & Hofmann, H. P. (2021). Effect of public corruption on the COVID-19 immunization progress. *Scientific Reports*, *11*(1), 23423. https://doi.org/10.1038/s41598-021-02802-1

Figueroa, J. P., Elena Bottazzi, M., Hotez, P., Batista, C., Ergonul, O., Gilbert, S., Gursel, M., Hassanain, M., Kim, J. H., Lall, B., Larson, H., Naniche, D., Sheahan, T., Shoham, S., Wilder-Smith, A., Strub-Wourgaft, N., Yadav, P., & Kang, G. (2021). Urgent needs of low-income and middle-income countries for COVID-19 vaccines and therapeutics. *The Lancet*, *397*(10274), 562–564. https://doi.org/10.1016/s0140-6736(21)00242-7

Goldberg, S. B., Lam, S. U., Otto, S., Torous, J., & Sun, S. (2022). Mobile phone-based interventions for mental health: A systematic meta-review of 14 meta-analyses of randomized controlled trials. *PLOS Digital Health*, *1*(1), e0000002. https://doi.org/10.1371/journal.pdig.0000002

Gørtz, M., Brewer, N. T., Hansen, P. R., & Ejrnæs, M. (2020). The contagious nature of a vaccine scare: How the introduction of HPV vaccination lifted and eroded MMR vaccination in Denmark. *Vaccine*, *38*(28), 4432–4439. https://doi.org/10.1016/j.vaccine.2020.04.055

Grácio, M., & Vicente, P. C. (2021). Information, get-out-the-vote messages, and peer influence: Causal effects on political behavior in Mozambique. *Journal of Development Economics*, *151*, 102665. https://doi.org/10.1016/j.jdeveco.2021.102665

Haaland, I., Roth, C., & Wohlfart, J. (2023). Designing information provision experiments. *Journal of Economic Literature*, *61*(1), 3–40. https://doi.org/10.1257/jel.20211658

Hays, R. D., Hayashi, T., & Stewart, A. L. (1989). A five-item measure of socially desirable response set. *Educational and Psychological Measurement*, *49*(3), 629–636. https://doi.org/10.1177/001316448904900315

Hoy, C., Wood, T., & Moscoe, E. (2022). Addressing vaccine hesitancy in developing countries: Survey and experimental evidence. *PLoS One*, *17*(11), e0277493. https://doi.org/10.1371/journal.pone.0277493

INE. (2021). Mozambican population in 2021. Updated at 08/08/2021 and available at Retrieved from http://www.ine.gov.mz/noticias/populacao-mocambicana-para-2021

Iribarren, S. J., Cato, K., Falzon, L., & Stone, P. W. (2017). What is the economic evidence for mHealth? A systematic review of economic evaluations of mHealth solutions. *PLoS One*, *12*(2), e0170581. https://doi.org/10.1371/journal.pone.0170581

Ivanov, B. (2012). Designing inoculation messages for health communication campaigns." health communication message design. *Theory and Practice*, 73–93.

Ivanov, B., Burns, W. J., TimothySellnow, L., Sayers, E. L. P., Veil, S. R., & Mayorga, M. W. (2016). Using an inoculation message approach to promote public confidence in protective agencies. *Journal of Applied Communication Research*, *44*(4), 381–398. https://doi.org/10.1080/00909882.2016.1225165

Kling, J. R., Liebman, J. B., & Katz, L. F. (2007). Experimental analysis of neighborhood effects. *Econometrica*, *75*(1), 83–119. https://doi.org/10.1111/j.1468-0262.2007.00733.x

Lazarus, J. V., ScottRatzan, C., Adam, P., Gostin, L. O., Larson, H. J., Rabin, K., Spencer, K., & El-Mohandes, A. (2021). A global survey of potential acceptance of a COVID-19 vaccine. *Nature Medicine*, *27*(2), 225–228. https://doi.org/10.1038/s41591-020-1124-9

Lewandowsky, S., UllrichEcker, K. H., ColleenSeifert, M., Schwarz, N., & Cook, J. (2012). Misinformation and its correction: Continued influence and successful debiasing. *Psychological Science in the Public Interest*, *13*(3), 106–131. https://doi.org/10.1177/1529100612451018

Lewandowsky, S., Werner, G. K. S., Freund, A. M., Oberauer, K., & I Krueger, J. (2013). Misinformation, disinformation, and violent conflict: From Iraq and the "war on terror" to future threats to peace. *American Psychologist*, *68*(7), 487–501. https://doi.org/10.1037/a0034515

Lowes, S., & Montero, E. (2021). The legacy of colonial medicine in central Africa. *The American Economic Review*, *111*(4), 1284–1314. https://doi.org/10.1257/aer.20180284

Martinez-Bravo, M., & Stegmann, A. (2021). *In vaccines we trust? The effects of the CIA's vaccine ruse on immunization in Pakistan*. Journal of the European Economic Association. jvab018).

McGuire, W. J. (1964). Inducing resistance to persuasion. Some contemporary approaches. *Advances in Experimental Social Psychology*, *1*, 191–229.

McKenzie, D. (2012). Beyond baseline and follow-up: The case for more T in experiments. *Journal of Development Economics*, *99*(2), 210–221. https://doi.org/10.1016/j.jdeveco.2012.01.002

Miller, C. H., Bobi, I., Jeanetta, S., Josh, C., Harrison, K. J., Parker, K. A., Parker, J. L., & M Averbeck, J. (2013). Boosting the potency of resistance: Combining the motivational forces of inoculation and psychological reactance. *Human Communication Research*, *39*(1), 127–155. https://doi.org/10.1111/j.1468-2958.2012.01438.x

Miller, C. H., Lane, L. T., Deatrick, L. M., AliceYoung, M., & Potts, K. A. (2007). Psychological reactance and promotional health messages: The effects of controlling language, lexical concreteness, and the restoration of freedom. *Human Communication Research*, *33*(2), 219–240. https://doi.org/10.1111/j.1468-2958.2007.00297.x

Ministry of Health of Mozambique (2021a). COVID-19 weekly reports. Available at https://www.misau.gov.mz/index.php/relatorio-situacional-semanal

Ministry of Health of Mozambique (2021b). Moçambique Recebe 200 mil Doses de Vacina da Sinopharm. Retrieved from https://www.misau.gov.mz/index.php/397-mocambique-recebe-200-mil-doses-de-vacina-da-sinopharm. Accessed on 27 March 2023.

Ministry of Health of Mozambique (2021c). National pandemic response plan for COVID-19 update 2021. Available at https://www.misau.gov.mz/index.php/covid-19-planos-nacionais-e-vacinacao

Ministry of Health of Mozambique (2021d). National vaccination plan against COVID-19. Available at https://www.misau.gov.mz/index.php/covid-19-planos-nacionais-e-vacinacao

Nyhan, B., & Reifler, J. (2010). When corrections fail: The persistence of political misperceptions. *Political Behavior*, *32*(2), 303–330. https://doi.org/10.1007/s11109-010-9112-2

Oliver-Williams, Clare, E. B., Devereux, S., Fairhead, C., Holeman, I.c, et al. (2017). Using mobile phones to improve vaccination uptake in 21 low-and middle-income countries: Systematic review. *JMIR mHealth and uHealth*, *5*(10), e7792.

Pfau, M., Bobi, I., Brian, H., Michel, H., Jeanetta, S., Eileen, G., Jason, R., Shelley, W., Jackie, E., & Natalie, R. (2005). Inoculation and mental processing: The instrumental role of associative networks in the process of resistance to counterattitudinal influence. *Communication Monographs*, *72*(4), 414–441. https://doi.org/10.1080/03637750500322578

Pfau, M., James Tusing, K., Koerner, A. F., Lee, W., Godbold, L. C., Penaloza, L. J., Shu-Huei, V., & Hong, Y.-H. (1997). Enriching the inoculation construct: The role of critical components in the process of resistance. *Human Communication Research*, *24*(2), 187–215. https://doi.org/10.1111/j.1468-2958.1997.tb00413.x

Rafkin, C., Shreekumar, A., & Vautrey, P.-L. (2021). When guidance changes: Government stances and public beliefs. *Journal of Public Economics*, *196*, 104319. URL. https://doi.org/10.1016/j.jpubeco.2020.104319 https://www.sciencedirect.com/science/article/pii/S0047272720301833

Roozenbeek, J., & Van Der Linden, S. (2019). The fake news game: Actively inoculating against the risk of misinformation. *Journal of Risk Research*, *22*(5), 570–580. https://doi.org/10.1080/13669877.2018.1443491

Roozenbeek, J., Van Der Linden, S., & Nygren, T. (2020). Prebunking interventions based on the psychological theory of "inoculation" can reduce susceptibility to misinformation across cultures. *Harvard Kennedy School Misinformation Review*, *1*(2). https://doi.org/10.37016//mr-2020-008

Sasaki, S., Saito, T., & Ohtake, F. (2022). Nudges for COVID-19 voluntary vaccination: How to explain peer information? *Social Science & Medicine*, *292*, 114561. https://doi.org/10.1016/j.socscimed.2021.114561

Solís Arce, J. S., Julio, S., Warren, S. S., Meriggi, N. F., Scacco, A., McMurry, N., Voors, M., Syunyaev, G., Abdul Malik, A., Aboutajdine, S., Adeojo, O., Armand, A., Asad, S., Atyera, M., Augsburg, B., Awasthi, M., Ayesiga, G. E., Bancalari, A., Björkman Nyqvist, M., & Omer, S. B. (2021). COVID-19 vaccine acceptance and hesitancy in low-and middle-income countries. *Nature Medicine*, *27*(8), 1385–1394. https://doi.org/10.1038/s41591-021-01454-y

UNICEF. (2021). Data warehouse. Available at https://data.unicef.org/resources/

Van der Linden, Sander, J. R., & Compton, J. (2020). Inoculating against fake news about COVID-19. *Frontiers in Psychology*, *11*, 2928.

Van der Linden, S. (2015). The conspiracy-effect: Exposure to conspiracy theories (about global warming) decreases pro-social behavior and science acceptance. *Personality and Individual Differences*, *87*, 171–173. https://doi.org/10.1016/j.paid.2015.07.045

VOA. 2021. "Moçambique recebe mais 484 mil vacinas contra a COVID-19." Retrieved from https://www.voaportugues.com. URL Retrieved from https://www.voaportugues.com/a/moçambique-recebe-mais-484-mil-vacinas-contra-contra-a-covid-19/5805655.html. Accessed on 27 March 2023.

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, *359*(6380), 1146–1151. https://doi.org/10.1126/science.aap9559

Wellcome Global Monitor. (2018). How does the World feel about science and health? Available at https://wellcome.org/reports/wellcome-global-monitor/2018

WHO (2020). WASH in health care facilities. Available at https://apps.who.int/immunization_monitoring/globalsummary/estimates?c=MOZ

WHO (2021a). Coronavirus disease (COVID-19) vaccines: QA. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-(covid-19)-vaccines? accessed 27 March 2023.

WHO (2021b). Global health observatory data repository. Available at https://apps.who.int/gho/data/node.main.A824?lang=en

WHO. 2021c. "Mozambique confirms wild poliovirus case." Retrieved from https://www.afro.who.int/countries/mozambique/news/mozambique-confirms-wild-poliovirus-case. [Accessed: 2023-03-24].

WHO (2021d). Poliomyelitis. URL https://www.who.int/news-room/q-a-detail/poliomyelitis. Accessed 24 March 2023.
Wong, N. C. H. (2016). Vaccinations are safe and effective": Inoculating positive HPV vaccine attitudes against antivaccination attack messages. *Communication Reports*, *29*(3), 127–138. https://doi.org/10.1080/08934215.2015.1083599
Wong, N. C. H., & Harrison, K. J. (2014). Nuances in inoculation: Protecting positive attitudes toward the HPV vaccine and the practice of vaccinating children. *Journal of Women's Health Issues Care*, *3*(6).
World Bank. (2021a). Mozambique economic update. Available at https://www.worldbank.org/en/news/press-release/2021/03/04/mozambique-economic-update-growth-expected-to-rebound-by-2022
World Bank. (2021b). World development indicators. Available at https://databank.worldbank.org/

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APPENDIX A: INTERVENTIONS AND TIMELINE

This section provides the scripts on each information module provided in the different interventions.

A1 | Endorsement module

During the endline survey, enumerators conveyed the following statement:

> It is important to vaccinate against COVID-19 because it is dangerous. While elderly and ill people are at additional risk, COVID-19 is potentially deadly for anyone. When you vaccinate, you reduce the probability of contracting the virus and of spreading it to others. Your vaccination contributes to protecting you and others from death or severe illness due to COVID-19.

We sent a reinforcement SMS text message 10 weeks after the conclusion of the endline survey with the following reminder:

> COVID-19 vaccine reduces the chance that you will get the virus and pass it on to others. The vaccine helps protect yourself and others from death or serious illness caused by COVID-19.

A2 | Social memory module

During the endline survey, enumerators conveyed the following statement:

> Do you remember the time when it was common to have new cases of wild polio? Many people used to suffer from paralysis due to this terrible disease. Thanks to the polio vaccine, Mozambique now has wild polio-free status. In other words, there are no longer any new cases in the country! The World Health Organization (WHO) has stated: 'This success is the result of a sustained, collective and collaborative effort between the Ministry of Health, partners, and the community. Only together we can achieve satisfactory results.

We sent a reinforcement SMS text message 10 weeks after the conclusion of the endline survey with the following reminder:

> Get the COVID-19 vaccine when you have the opportunity. Thanks to the polio vaccine, Mozambique is free from wild polio. This was the result of collaboration between the health authorities and the community. Together, we have achieved good results.

A3 | *Inoculation* module

During the endline survey, enumerators guided respondents through the following interactive questions:

> What is your worst fear about getting the COVID-19 vaccine? Let's now imagine the following situation: let's exaggerate what you told me and imagine your worst fear is a true fact that applies to everyone. What do you think will happen if you decide to spread to other people this imagined fact? What do you think will happen if many people do the same, i.e., share an exaggerated version of their own fears?

Enumerators then conveyed the following statement to conclude the exercise:

> A lot of information that circulates in person-to-person contact is not based on facts. We need to pay attention to official information, particularly when it relates to vaccines. Even more, we should think about the potential consequences when we decide to share information we are not sure about. Scientific evidence shows that the dissemination of false information can influence people's choices and lead to serious consequences.

We sent a reinforcement SMS text message 10 weeks after the conclusion of the endline survey with the following reminder:

> Pay attention to the official information about the COVID-19 vaccine. A lot of information circulating is not true. Sharing information you are not sure about can influence the choices of others with serious consequences. Vaccines improve the health of the country. Get the COVID-19 vaccine when you have the opportunity.

A4 | Calling protocol

We equipped each enumerator with a list of respondents. We then assigned respondents randomly while accounting for the enumerators' province of residence and language (see Section 3.3). Enumerators would make a single attempt for each contact in the list. Upon trying to contact the whole list, enumerators would reach out to the team supervisor to record a complete round. Upon the supervisor's authorization, enumerators would start a new round, following the same order for the missing respondents, that is, those without a complete interview and who had not declined to participate. We created exceptions to the sequential progress in the list in case of unexpected interruptions in communication, rescheduled or incoming calls.

A5 | Timeline

Figure A1 shows the timeline of measurements and interventions, superimposed on the rolling 7-day average of daily new confirmed COVID-19 cases over the entire duration of the study. Figure A2 shows the evolution of acceptance of the

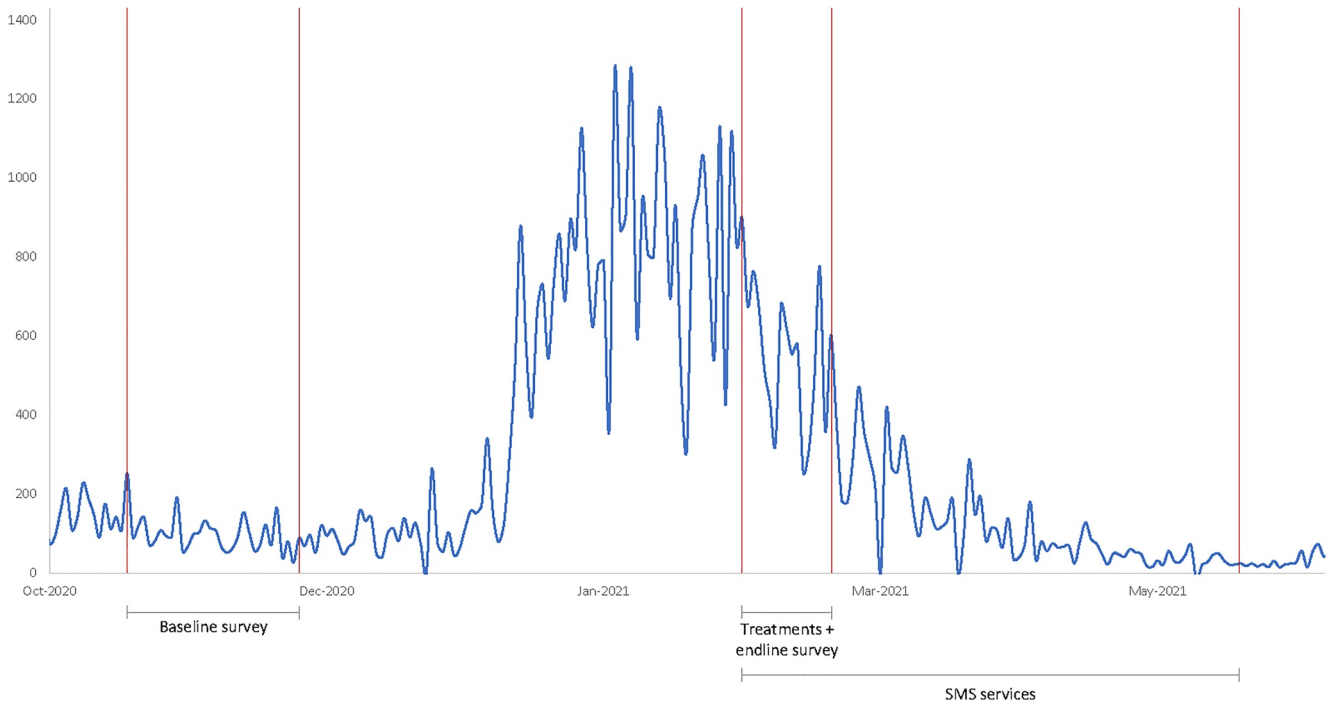

FIGURE A1 Evolution of COVID-19 cases and study timeline. Timeline of measurements and interventions superimposed on the evolution of the rolling 7-day average of daily new confirmed COVID-19 cases in Mozambique, from October 16th of 2020 to May 3rd of 2021. The number of confirmed cases may be lower than the number of actual cases because of limited testing. *Source*: Our World in Data. The baseline survey was implemented between October 30th and November 30th of 2020; the treatments and the endline survey between February 18th and March 6th of 2021; the SMS services between February 18th and May 19th of 2021.

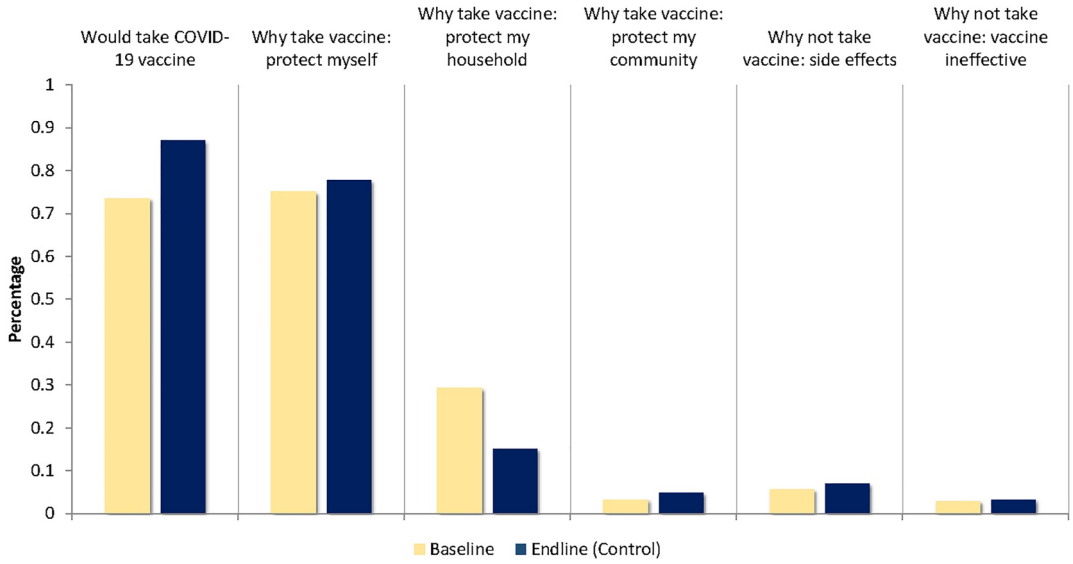

FIGURE A2 Evolution of acceptance of COVID-19 vaccine. 'Baseline' reports the average answer computed considering all respondents to the baseline survey. 'Endline (control)' reports the average answer computed considering only those respondents to the endline survey who were assigned to the control group and who did not receive any message under the study. From left to right, the outcomes reported are defined by the following: (1) *Would take COVID-19 vaccine*: indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'When a COVID-19 vaccine becomes available in the future, would you take it?', and 0 otherwise; (2) *Why take vaccine: protect myself*: indicator variable that takes value 1 if respondent chose 'I want to protect myself from having COVID-19 in the future' in response to the question: 'Why would you take it?' - conditional on having answered 'Yes' to the question in (1), and 0 otherwise; (3) *Why take vaccine: protect my household*: indicator variable that takes value 1 if respondent chose 'I want to protect my family/members of my household against having COVID-19 in the future' in response to the question: 'Why would you take it?' - conditional on having answered 'Yes' to the question in (1), and 0 otherwise; (4) *Why take vaccine: protect my community*: indicator variable that takes value 1 if respondent chose 'I want to protect my community against having COVID-19 in the future' in response to the question: 'Why would you take it?' - conditional on having answered 'Yes' to the question in (1), and 0 otherwise; (5) *Why not take vaccine: side effects*: indicator variable that takes value 1 if respondent chose 'I would be concerned about possibility that the side effects from the vaccine are harmful' in response to the question: 'Why would you not take it?' - conditional on having answered 'No' to the question in (1), and 0 otherwise; (6) *Why not take vaccine*: vaccine ineffective: indicator variable that takes value 1 if respondent chose 'I don't think vaccines are effective' in response to the question: 'Why would you not take it?' - conditional on having answered 'No' to the question in (1), and 0 otherwise.

COVID-19 vaccine from the baseline to the endline survey across a range of survey questions. Baseline values are computed considering all respondents to the baseline survey, while the endline values consider only those respondents who were assigned to the control group and who did not receive any message under the study.

APPENDIX B: BEHAVIORAL MEASUREMENTS

The behavioral measurements were implemented in conjunction with the 'Associação NOVAFRICA para o Desenvolvimento Empresarial e Económico de Moçambique', the local partner of NOVAFRICA in Mozambique.

B1 | Information service on COVID-19 vaccination

The invitation message is as follows:

> Do you want to receive updates about the Coronavirus vaccine in Mozambique from the NOVAFRICA team? If yes, please answer "YES" to this text message.

The timing is the following: a first text message invitation is sent on the same day of the interview, followed by a reminder on the next day and a weekly reminder after that. The research team would stop sending invitations as soon as the respondent subscribes to the service. This SMS service is similar to the public information phone helpline that the Ministry of Health is establishing at the national level.

B2 | Feedback to the Ministry of Health

The invitation message is as follows:

> Do you want to send a message, either praise or criticism, to the Ministry of Health? If yes, reply to this text message with your message. The NOVAFRICA team will communicate it to the Ministry. Thank you, NOVAFRICA.

The timing is the following: a first text message invitation is sent on the same day of the interview, followed by a reminder on the next day and a weekly reminder after that. The research team would keep sending invitations even after respondents sent the first message. The Ministry of Health highlights the intention to proactively listen to the population and their concerns, doubts, fears, insecurity, or lack of confidence in institutions.

B3 | Debunk fake news to specific phone numbers

The invitation message is as follows:

> Identify false rumors about COVID-19 and contribute to the spread of truthful information. Send to this number the false rumors you have heard. You can also send a phone number to which you want the NOVAFRICA team to forward the correct information. Thank you, NOVAFRICA.

The timing is the following: a first text message invitation is sent on the same day of the interview, followed by a reminder the following day, and a weekly reminder after that. The research team would keep sending invitations even after respondents sent the first message. The Ministry of Health already has a rumor monitor and mitigation mechanism, which uses the information received to mitigate rumors' impact on health behaviors.

APPENDIX C: RANDOMIZATION AND SELECTIVE ATTRITION

Figure C1 shows assignment to treatment groups of participants. Table C1 presents descriptive statistics of the sample and provides mean comparisons across treatment groups, including a joint test of equality to zero of all these differences. Table C2 presents descriptive statistics about attrition from the baseline to the follow-up survey and provides evidence against the presence of selective attrition across treatment groups.

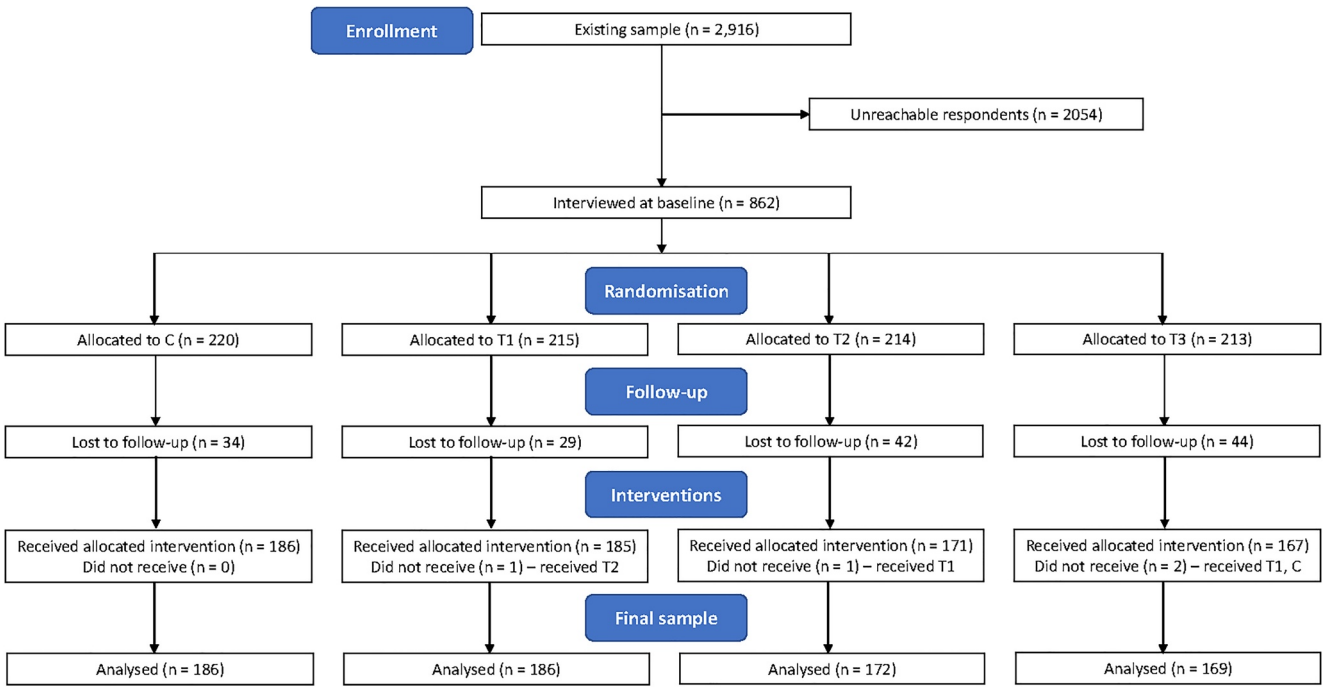

FIGURE C1 Experimental design—CONSORT diagram.

TABLE C1 Balance across treatment arms.

	N (1)	Control mean (2)	T1 (3)	T2 (4)	T3 (5)	*F*-test pvalue (6)
Gender (female = 1)	713	0.40	−0.01	−0.03	−0.02	0.936
			(0.05)	(0.05)	(0.05)	
Age	712	46.21	0.69	−0.65	0.06	0.796
			(1.30)	(1.33)	(1.34)	
Household size	712	5.38	−0.18	−0.04	−0.08	0.951
			(0.31)	(0.32)	(0.32)	
Education - 12 years or more	713	0.17	0.01	−0.01	−0.05	0.491
			(0.04)	(0.04)	(0.04)	
Catholic	713	0.29	−0.08	−0.03	−0.06	0.371
			(0.05)	(0.05)	(0.05)	
Protestant	713	0.37	0.06	0.02	0.01	0.659
			(0.05)	(0.05)	(0.05)	
Muslim	713	0.24	0.06	0.02	0.06	0.469
			(0.04)	(0.05)	(0.05)	
Total income - past week	592	2933.99	734.33	72.11	618.26	0.275
			(452.40)	(463.96)	(470.51)	

Note: Column (1) reports the number of observations. Column (2) reports the sample mean of the pure control group. Columns (3), (4), and (5) report estimates for each treatment indicator variable in Equation (1). Column (6) reports the joint *p*-value of the *F*-test including all the treatments. A 90% winsorization was applied to *Total income - past week*. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE C2 Survey attrition from baseline to endline.

	N (1)	Control mean (2)	T1 (3)	T2 (4)	T3 (5)	*F*-test pvalue (6)
Attrition	862	0.17	−0.02	0.04	0.05	0.177
			(0.04)	(0.04)	(0.04)	

Note: *Attrition* is defined as indicator variable equal to 1 if the respondent was interviewed at baseline and not interviewed at follow-up, and 0 otherwise. Column (1) reports the number of observations. Column (2) reports the sample mean of the pure control group. Columns (3), (4), (5) report estimates for each treatment indicator variable in Equation (1). Column (6) reports the joint *p*-value of the *F*-test including all the treatments. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

APPENDIX D: ADDITIONAL RESULTS

D1 | Treatment effects on aggregated outcomes

Table D1 provides estimates of treatment effects on the aggregated outcomes built using the procedure in Kling et al. (2007) and detailed in Section 5.4. Table D2 shows instead estimates of heterogeneous treatment effects for the same indices.

TABLE D1 Treatment effects on aggregated outcomes.

	Vaccine acceptance (1)	Trust in institutions (2)	Desirability bias (3)	Behavioral measures (4)
T1	0.078	0.115**	−0.022	0.075
	(0.069)	(0.046)	(0.047)	(0.085)
T2	0.141**	0.115**	−0.060	0.113
	(0.065)	(0.045)	(0.054)	(0.096)
T3	0.267***	0.187***	−0.030	0.035
	(0.071)	(0.046)	(0.049)	(0.087)
N	709	710	710	698
Mean dep. Variable (control)	0.003	−0.001	0.000	0.000
Baseline	NO	NO	NO	NO
R^2	0.145	0.110	0.106	0.050
Equality of treatment effects (p-values)				
T1 = T2	0.227	1.000	0.406	0.712
T1 = T3	0.005	0.128	0.865	0.635
T2 = T3	0.045	0.092	0.479	0.449
T1 = T2 = T3 = 0	0.002	0.001	0.726	0.637

Note: Estimates based on OLS regressions using Equation (1). Outcomes are grouped in indices that are built using the procedure in Kling et al. (2007). The procedure is detailed in Section 5.4. The indices are defined by the following outcomes: (1) *Vaccine acceptance* includes the outcomes in columns (1)-(5) of Table 1; (2) *Trust in institutions* includes the outcomes in columns (1)-(5) of Table 2; (3) *Desirability bias* includes the outcomes of Table 3; (4) *Behavioral measures* includes the outcomes of Table 4. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE D2 Heterogeneous treatment effects on aggregated outcomes.

	Vaccine acceptance (1)	Trust in institutions (2)	Behavioral measures (3)
Gender			
T1 X female	0.117	0.205**	−0.102
	(0.131)	(0.097)	(0.177)
T2 X female	0.069	−0.019	−0.016
	(0.137)	(0.098)	(0.195)
T3 X female	0.129	0.142	−0.205
	(0.142)	(0.117)	(0.156)
Age			
T1 X Under 40	0.061	−0.188	−0.333*
	(0.131)	(0.126)	(0.180)
T2 X Under 40	0.069	0.104	0.158
	(0.126)	(0.094)	(0.217)
T3 X Under 40	0.096	−0.049	−0.058
	(0.137)	(0.106)	(0.188)
Sample			
T1 X Cabo Delgado	0.020	−0.046	0.145
	(0.139)	(0.097)	(0.180)
T2 X Cabo Delgado	−0.022	−0.180*	0.237
	(0.128)	(0.095)	(0.212)
T3 X Cabo Delgado	−0.269*	−0.299***	0.293
	(0.142)	(0.093)	(0.187)
N	710	710	698

Note: Estimates based on OLS regressions using Equation (1). Outcomes are grouped in indices that are built using the procedure in Kling et al. (2007). The procedure is detailed in Section 5.4. The indices are defined by the following outcomes: (1) *Vaccine acceptance* includes the outcomes in columns (1)-(5) of Table 1; (2) *Trust in institutions* includes the outcomes in columns (1)-(5) of Table 2; (3) *Behavioral measures* includes the outcomes of Table 4. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D2 | Adding treatment duration as control

TABLE D3 Acceptance of COVID-19 vaccine.

			COVID-19 vaccines are ..				
	Willingness to take vaccine (1)	Would be among the first to take (2)	Effective (3)	Safe (4)	Without side effects (5)	Why take: protect myself (6)	Why not take: side effects (7)
T1	−0.011	0.022	0.149	0.102	0.166	0.025	0.004
	(0.026)	(0.044)	(0.093)	(0.097)	(0.106)	(0.035)	(0.022)
T2	0.052	0.046	0.249***	0.144	0.047	0.063*	−0.019
	(0.034)	(0.050)	(0.096)	(0.106)	(0.096)	(0.034)	(0.027)
T3	0.060**	0.101**	0.253**	0.398***	0.327***	0.044	−0.041*
	(0.030)	(0.042)	(0.099)	(0.097)	(0.104)	(0.038)	(0.022)
N	698	691	685	683	688	698	698
Mean dep. Variable (control)	0.870	0.645	3.418	3.315	2.960	0.778	0.070
Baseline	YES	NO	NO	NO	NO	YES	YES
Controls	Duration	Duration	Duration	Duration	Duration	Duration	Duration
R^2	0.102	0.165	0.107	0.117	0.158	0.100	0.059
Equality of treatment effects (p-values)							
T1 = T	0.050	0.542	0.251	0.670	0.240	0.189	0.376
T1 = T3	0.008	0.051	0.245	0.000	0.107	0.594	0.050
T2 = T3	0.828	0.262	0.974	0.011	0.014	0.591	0.305
T1 = T2 = T3 = 0	0.021	0.070	0.029	0.000	0.018	0.259	0.177

Note: Estimates based on OLS regressions. Columns (2)–(5) present estimates using Equation (1), columns (1), (6), and (7) present estimates using Equation (2), which includes the lagged dependent variable (ANCOVA). Depending on the column, the dependent variables are defined by the following. (1): indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'When a COVID-19 vaccine becomes available in the future, would you take it?', and 0 otherwise. (2): indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'Would you like to be among the first ones to get vaccinated against COVID-19 when the vaccine becomes available?', and 0 otherwise. (3)–(5): variables using a 5-item Likert scale that takes the values 1 'Strongly disagree,' 2 'Disagree,' 3 'Neither agree nor disagree,' 4 'Agree,' and 5 'Strongly agree' to measure agreement with the following statements: (3) 'The COVID-19 vaccines currently produced are effective in preventing the disease;' (4) 'The COVID-19 vaccines currently produced are safe; ' (5) 'The vaccines against COVID-19 currently produced might bring some serious side effects' [Reversed]. (6): indicator variable that takes value 1 if respondent chose 'I want to protect myself from having COVID-19 in the future' in response to the question: 'Why would you take it?' - conditional on having answered 'Yes' to the question in (1), and 0 otherwise. (7): indicator variable that takes value 1 if respondent chose 'I would be concerned about the possibility that the side effects from the vaccine are harmful' in response to the question: 'Why would you not take it?', and 0 otherwise. The full list of controls is presented in Section 4. *Duration* represents the total duration of the interview, winsorized at the 95% level. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE D4 Trust in institutions.

	On vaccines, the government ..						
	Decides in population's best interest (1)	Purchases highest quality (2)	Appropriate COVID-19 reaction (3)	Local government not involved in corruption (4)	Willingness to visit health facility if infected (5)	Leaders support vaccines (6)	Community willing to take the vaccine (7)
T1	0.203**	0.112	0.002	0.222	0.038*	0.019	0.003
	(0.079)	(0.087)	(0.042)	(0.138)	(0.020)	(0.075)	(0.088)
T2	0.119	0.221**	0.035	−0.040	0.038**	0.024	0.118
	(0.079)	(0.101)	(0.041)	(0.115)	(0.017)	(0.087)	(0.074)
T3	0.260***	0.203**	0.076*	0.257**	0.033*	0.053	0.017
	(0.086)	(0.102)	(0.046)	(0.130)	(0.020)	(0.108)	(0.086)
N	692	687	680	631	710	681	695
Mean dep. Variable (control)	3.606	3.306	0.628	2.494	0.946	3.578	3.547
Baseline	NO	NO	YES	NO	YES	NO	NO
Controls	Duration	Duration	Duration	Duration	Duration	Duration	Duration
R^2	0.237	0.161	0.195	0.121	0.076	0.067	0.095
Equality of treatment effects (*p-values*)							
T1 = T2	0.367	0.320	0.428	0.052	0.990	0.956	0.136
T1 = T3	0.461	0.312	0.130	0.792	0.760	0.745	0.885
T2 = T3	0.083	0.852	0.359	0.014	0.752	0.787	0.182
T1 = T2 = T3 = 0	0.019	0.128	0.353	0.051	0.153	0.970	0.251

Note: Estimates based on OLS regressions. Columns (1), (2), (3), (4), and (6) present estimates using Equation (1), columns (5), (7) present estimates using Equation (2), which includes the lagged dependent variable (ANCOVA). Depending on the column, the dependent variables are defined by the following. (1), (2), (3), (4), and (6): variables using a 5-item Likert scale that takes the values 1 'Strongly disagree,' 2 'Disagree,' 3 'Neither agree nor disagree,' 4 'Agree,' 5 'Strongly agree' to measure agreement with the following statements: (1) 'The national government is making decisions in your best interest with respect to which COVID-19 vaccines are provided;' (2) 'The national government purchases the highest quality COVID-19 vaccines available;' (3) 'Leaders (religious, political, teachers, health care workers) in your community support the COVID-19 vaccines currently produced;' (4) 'People in your community/circle of friends are willing to take the COVID-19 vaccine;' (6) 'Agents of your local government (provincial, district, or municipal) are involved in corruption'. (5): indicator variable that takes value 1 if respondent answered 'The reaction is appropriate' to the question: 'What do you think about the reaction of your country's government to the current COVID-19 outbreak?' (answers available: 1 'The reaction is very exaggerated,' 2 'The reaction is exaggerated,' 3 'The reaction is appropriate,' 4 'The reaction is insufficient,' 5 'The reaction is very insufficient'), and 0 otherwise. (7): indicator variable that takes value 1 if respondent chose a health facility in response to the question: 'If you thought you had COVID-19, where would you seek treatment?', and 0 otherwise. The full list of controls is presented in Section 4. *Duration* represents the total duration of the interview, winsorized at the 95% level. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE D5 Social desirability.

	Social desirability index (1)	Went to market (frequency) (2)	Went to Church or mosque (3)	Washed hands more often (4)	Used face mask (5)	Household member received polio vaccine (6)	Willingness to vaccinate newborn against polio (7)
T1	−0.005	0.016	0.001	0.010	0.000	−0.003	−0.032
	(0.018)	(0.153)	(0.027)	(0.031)	(0.008)	(0.031)	(0.021)
T2	−0.035*	−0.003	−0.008	−0.015	−0.007	0.011	−0.007
	(0.019)	(0.132)	(0.031)	(0.034)	(0.010)	(0.027)	(0.019)
T3	−0.024	0.202	−0.036	−0.014	0.001	0.005	−0.008
	(0.020)	(0.126)	(0.033)	(0.039)	(0.008)	(0.031)	(0.019)
N	705	699	709	708	709	478	685
Mean dep. Variable (control)	0.114	3.098	0.118	0.887	0.995	0.949	0.967
Baseline	NO	YES	YES	YES	YES	NO	NO
Controls	Duration	Duration	Duration	Duration	Duration	Duration	Duration
R^2	0.296	0.084	0.149	0.094	0.033	0.065	0.114

TABLE D5 (Continued)

	Social desirability index (1)	Went to market (frequency) (2)	Went to Church or mosque (3)	Washed hands more often (4)	Used face mask (5)	Household member received polio vaccine (6)	Willingness to vaccinate newborn against polio (7)
Equality of treatment effects (*p-values*)							
T1 = T2	0.129	0.912	0.734	0.425	0.421	0.678	0.246
T1 = T3	0.309	0.212	0.210	0.434	0.951	0.797	0.250
T2 = T3	0.506	0.203	0.364	0.985	0.431	0.856	0.997
T1 = T2 = T3 = 0	0.288	0.379	0.622	0.833	0.851	0.971	0.478

Note: Estimates based on OLS regressions. Columns (1), (6), and (7) present estimates using Equation (1), columns (2), (3), (4), and (5) present estimates using Equation (2), which includes the lagged dependent variable (ANCOVA). Depending on the column, the dependent variables are defined by the following. (1): index of equally weighted variables recording as 1 the most extreme positive answer to the scale 1 'Definitely false,' 2 'False,' 3 'Don't know,' 4 'True,' 5 'Definitely true' in response to the following statements: 'I am always courteous even to people who are disagreeable;' 'There have been occasions when I took advantage of someone' [Reversed]; 'I sometimes try to get even rather than forgive and forget' [Reversed]; 'I sometimes feel resentful when I don't get my way' [Reversed]; 'No matter who I'm talking to, I'm always a good listener.' (2): variable that takes the values 1 'Never (0 days),' 2 'Once (1 day),' 3 'Some days (2–3 days),' 4 'Most days (4–6 days),' 5 'Every day (7 days)' in response to the question: 'In the past 7 days, how often did members of your household go to a market or food store?' (3): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'In the past 7 days, have you attended Church or mosque, or gathered with people from outside your household to pray?', and 0 otherwise. (4): indicator variable that takes value 1 if respondent answered 'More' to the question: 'In the past 7 days, have you washed your hands with soap and water more often, less often, or about the same as you did before the government closed schools?' (answers available: 'Less,' 'Same,' 'More,' 'Don't know'), and 0 otherwise. (5): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'In the last 7 days have you always worn a face mask or other nose/mouth covering when going out in public?', and 0 otherwise. (6): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'Has any member of your household ever received any vaccination drops in the mouth to protect (him/her) from polio?', and 0 otherwise. (7): indicator variable that takes value 1 if respondent answered 'Yes' to the question: 'If you had a newborn in the household would you want to vaccinate him/her against polio?', and 0 otherwise. The full list of controls is presented in Section 4. *Duration* represents the total duration of the interview, winsorized at the 95% level. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

TABLE D6 Behavioral text messages.

	Subscribed to information service on COVID-19 (1)	Total number of text messages to ministry of health (2)	Total number of text messages to debunk fake news (3)
T1	−0.032	0.151*	0.027
	(0.049)	(0.079)	(0.075)
T2	0.005	0.130	0.072
	(0.048)	(0.081)	(0.092)
T3	−0.057	0.042	0.085
	(0.053)	(0.082)	(0.083)
N	698	698	698
Mean dep. Variable (control)	0.495	0.288	0.234
Baseline	NO	NO	NO
Controls	Duration	Duration	Duration
R^2	0.066	0.045	0.049
Equality of treatment effects (*p-values*)			
T1 = T2	0.454	0.801	0.649
T1 = T3	0.578	0.185	0.446
T2 = T3	0.167	0.286	0.901
T1 = T2 = T3 = 0	0.557	0.169	0.695

Note: Estimates based on OLS regressions. Columns (1)–(4) present estimates using Equation (1). (1): indicator variable that takes value 1 if respondent answered "Yes" to the invitation to subscribe to the COVID-19 vaccine information service, and 0 otherwise. (2): total number of text messages received in response to the invitation to send feedback to the Ministry of Health on its management of the pandemic situation. (3): total number of text messages received in response to the invitation to send unverified information to be debunked to specific phone numbers. The full list of controls is presented in Section 4. *Duration* represents the total duration of the interview, winsorized at the 95% level. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D3 | Vaccine acceptance and trust in institutions

Table D7 reports estimates of OLS regressions in which outcome variables capture vaccine acceptance at both baseline, in column (1), and endline, in columns (2)–(6), and the main independent variable is a measure of trust in institutions at baseline. In this section, we measure trust in institutions using respondents' agreement with the following statement "The national government, through the health system, is protecting your household from COVID-19". Agreement is captured using a Likert-5 scale. We believe this measure captures an individual's trust in the government in the fight against COVID-19. We focus on this measure of trust because it is the only available measure of trust at baseline. The other measures of trust in institutions studied in the main text are available only at endline.

TABLE D7 Trust in institutions and acceptance of COVID-19 vaccine.

				COVID-19 vaccines are ..		
	Willingness to take vaccine (baseline) (1)	Willingness to take vaccine (endline) (2)	Would be among the first to take (3)	Effective (4)	Safe (5)	Without side effects (6)
Trust government against COVID-19	0.197***	0.086***	0.103***	0.244***	0.275***	0.135***
	(0.0527)	(0.019)	(0.022)	(0.050)	(0.043)	(0.040)
N	702	695	687	684	680	685
R^2	0.066	0.138	0.207	0.166	0.184	0.172

Note: *Trust government against COVID-19* is measured at baseline. Column (1) presents correlation estimates based on OLS regressions. Columns (2)—(6) present correlation estimates based on OLS regressions controlling for treatment assignment. Depending on the column, the dependent variables are defined by the following. (1): baseline indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'When a COVID-19 vaccine becomes available in the future, would you take it?', and 0 otherwise. (2): endline indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'When a COVID-19 vaccine becomes available in the future, would you take it?', and 0 otherwise. (3): indicator variable that takes value of 1 if respondent answered 'Yes' to the question: 'Would you like to be among the first ones to get vaccinated against COVID-19 when the vaccine becomes available?', and 0 otherwise. (3)–(5): variables using a 5-item Likert scale that takes the values 1 'Strongly disagree,' 2 'Disagree,' 3 'Neither agree nor disagree,' 4 'Agree,' and 5 'Strongly agree' to measure agreement with the following statements: (3) 'The COVID-19 vaccines currently produced are effective in preventing the disease;' (4) 'The COVID-19 vaccines currently produced are safe;' (5) 'The vaccines against COVID-19 currently produced might bring some serious side effects' [Reversed]. The full list of controls is presented in Section 4. Standard errors (reported in parentheses) are clustered at the enumeration area level. Significance level: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D4 | Cost effectiveness of the intervention

TABLE D8 Cost-benefit analysis.

	US Dollars 2021 (1)	US Dollars 2021 PPP (2)
Total cost endline + intervention	8914.36	24,535.95
Total cost T1	813.9	2240
Cost T1 per respondent	4.4	12.0
Total cost T2	790.9	2177
Cost T2 per respondent	4.6	12.7
Total cost T3	1239.5	3411.5
Cost T3 per respondent	7.3	20.2
Cost T1 per additional SD	14.6	40.3
Cost T2 per additional SD	7.9	21.7
Cost T3 per additional SD	6.5	17.9

Note: Column (1) reports the values in US Dollars in 2021 when the intervention was implemented (World Development Indicators, The World Bank, Indicator Code: PA.NUS.FCRF). Column (2) corrects for Purchase Power Parity (World Development Indicators, The World Bank, Indicator Code: PA.NUS.PPP). *Total Cost Endline + Intervention* reports the costs of the entire endline survey in which the treatments were embedded. *Total Cost T1*, *Total Cost T2*, and *Total Cost T3* were computed considering the sample size and duration (winsorized at 95%) of each treatment. *Cost T1* per *respondent*, *Cost T2* per *respondent*, and *Cost T3* per *respondent* were computed considering the sample size of each treatment. *Cost T1* per *additional SD*, *Cost T2* per *additional SD*, and *Cost T3* per *additional SD* report the cost of raising vaccine acceptance by 1 standard deviation. To compute these values, we followed the methodology described in (Dhaliwal et al., 2013). Note that T1 does not have a significant effect on vaccine acceptance.

D5 | Power calculations

TABLE D9 Minimum detectable effect sizes for aggregated outcomes.

	Vaccine acceptance (1)	Trust in institutions (2)	Desirability bias (3)	Behavioral measures (4)
T1 versus control	0.078	0.115**	−0.022	0.075
	(0.069)	(0.046)	(0.047)	(0.085)
Ex-post 2-sided	0.193	0.129	0.132	0.238
Ex-post 1-sided	0.097	0.064	0.066	0.119
Ex-ante 2-sided without attrition	0.269	0.269	0.269	0.269
Ex-ante 1-sided without attrition	0.239	0.239	0.239	0.239
Ex-ante 2-sided with attrition	0.291	0.291	0.291	0.291
Ex-ante 1-sided with attrition	0.258	0.258	0.258	0.258
T2 versus control	0.141**	0.115**	−0.060	0.113
	(0.065)	(0.045)	(0.054)	(0.096)
Ex-post 2-sided	0.182	0.126	0.151	0.269
Ex-post 1-sided	0.091	0.063	0.076	0.134
Ex-ante 2-sided without attrition	0.270	0.270	0.270	0.270
Ex-ante 1-sided without attrition	0.239	0.239	0.239	0.239
Ex-ante 2-sided with attrition	0.297	0.297	0.297	0.297
Ex-ante 1-sided with attrition	0.264	0.264	0.264	0.264
T3 versus control	0.267***	0.187***	−0.030	0.035
	(0.071)	(0.046)	(0.049)	(0.087)
Ex-post 2-sided	0.199	0.129	0.137	0.244
Ex-post 1-sided	0.099	0.064	0.069	0.122
Ex-ante 2-sided without attrition	0.270	0.270	0.270	0.270
Ex-ante 1-sided without attrition	0.239	0.239	0.239	0.239
Ex-ante 2-sided with attrition	0.299	0.299	0.299	0.299
Ex-ante 1-sided with attrition	0.265	0.265	0.265	0.265

Note: Estimates report the Minimum Detectable Effect Sizes (MDES) in standard deviations, assuming a power level of 0.8 and a significance level of 0.05. For reference, we report the estimates of Table D1. For each treatment and outcome, we report six MDES. Ex-post 2-sided MDES is computed by multiplying the standard error reported in parentheses by 2.80. Ex-post 1-sided MDES is computed by multiplying the standard error reported in parentheses by 1.40, assuming a positive treatment effect. Ex-ante 2-sided without attrition is computed using the Stata command *power* considering a control group size of 220 and treatment group sizes of 215, 214, and 213 for T1, T2, and T3, respectively. Ex-ante 1-sided without attrition is computed using the Stata command *power* considering the same group sizes as Ex-ante 2-sided without attrition, and using the option *onesided*, assuming a positive treatment effect. Ex-ante 2-sided with attrition is computed using the Stata command *power* considering a control group size of 186 and treatment group sizes of 186, 172, and 169 for T1, T2, and T3, respectively. Ex-ante 1-sided with attrition is computed using the Stata command *power* considering the same group sizes as Ex-ante 2-sided with attrition, and using the option *onesided*, assuming a positive treatment effect.