The impact of large-scale social media advertising campaigns on COVID-19 vaccination: Evidence from two randomized controlled trials

By LISA HO, EMILY BREZA, ABHIJIT BANERJEE, ARUN G. CHANDRASEKHAR, FATIMA C. STANFORD, RENATO FIOR, PAUL GOLDSMITH-PINKHAM, KELLY HOLLAND, EMILY HOPPE, LOUIS-MAËL JEAN, LUCY OGBU-NWOBODO, BENJAMIN A. OLKEN, CARLOS TORRES, PIERRE-LUC VAUTREY, ERICA WARNER, ESTHER DUFLO AND MARCELLA ALSAN*

* Marcella Alsan: Harvard Kennedy School of Government; 79 John F. Kennedy Street, Cambridge, MA 02138, USA (e-mail: marcella_alsan@hks.harvard.edu). We thank Angelica Chin, Jane Hu, Nic Minudri, Jose Angel Cazares Torres, and Elsa Trezeguet for their excellent research assistance. We are also very grateful to Dr. Sarah Liegl (St. Anthony North Family Medicine) and Dr. Susan Wootton (McGovern Medical School) as well as several doctors in the Paris hospital system who volunteered their time to create videos about COVID-19 vaccination to disseminate to study participants. We thank Nisha Deolalikar for supporting the study at Facebook. Facebook provided financial and logistical support by running the COVID-19 related ads for free, as well as by hiring a marketing company (Code3 Creative) to manage the ad campaign.

I. Introduction

Despite widespread availability of COVID-19 vaccination in wealthy countries, many people remain unvaccinated. In the US, 72.9% of adults were fully vaccinated (with two doses) and only 13.5% were up to date with boosters as of December 2022, according to the CDC. Understanding why common strategies to encourage vaccination have worked or not therefore remains critical.

During the COVID-19 crisis, many healthcare professionals used social media to spread public health messages, and this strategy has been an important part of the effort to promote vaccination (e.g. Altman 2021). Nurses and physicians are among the most trusted experts in the US and Europe (Altman 2021, Lévy et al. 2019). However, some people may be mistrustful of experts and may react better to advice from laypeople, who are more similar to them and whose experience may be more relevant (see Alsan & Eichmeyer 2021 for an example in the context of flu). Therefore, activating local social networks could be another (potentially complementary) strategy to promote vaccination (Alatas et al. 2019, Chevrel & Éveillard 2021).

In previous work, some of the authors found empirical evidence that both of these approaches could be promising. First, we found that video messages sent by physicians and nurses had meaningful impacts in terms of improved COVID-19 knowledge and willingness to pay for masks (Alsan et al. 2021, Torres et al. 2021). Moreover, videos sent to millions of Facebook users in fall 2020 to encourage them not to travel for the Thanksgiving and Christmas holidays led to a significant decrease in distance traveled and subsequent COVID-19 infections (Breza et al. 2021). Second, Banerjee et al. (2019) found that the most effective way to identify locally influential people was to simply ask members of their social network who is best placed to circulate a piece of information. Then, in villages where such people were reminded approximately once per month to tell their friends and acquaintances that they should get vaccinated, immunization rates in the village increased (Banerjee et al. 2019). However, evidence that these strategies are effective to promote COVID-19 vaccination is lacking. Months after the vaccine was introduced, could this type of light-touch outreach still persuade the unvaccinated, or were opinions sufficiently hardened to be too difficult to change? We address this gap by conducting two large scale RCTs in the US and in France.

In both countries, physicians and nurses recorded short videos to promote COVID-19 vaccination and address common doubts about vaccination. In winter 2021-2022, at the height of the Omicron wave, these messages were placed as sponsored messages on Facebook. The ads were shown in randomly selected areas with low vaccination rates relative to the rest of the country, with random variation in outreach strategies, including whether the ads encouraged users to leverage their social networks.

Despite the ads reaching over 29 million distinct Facebook users and achieving relatively high engagement metrics, we fail to reject the null of no impact on any of the treatments on any of the outcomes (first, second, and booster shots in the US, and first doses in France). At the height of the Omicron wave, a large-scale social media campaign with a variety of professionally-produced video messages delivered by experts was ineffective at changing minds.

II. Study design

A. Treatments & Randomization

Facebook users received short (≈ 30 second) videos featuring doctors and nurses addressing common questions and misconceptions about COVID-19 vaccination, usually wearing medical uniforms. The ad campaigns were optimized for the Facebook "reach" objective, with budget allocations roughly proportional to population. We summarize them below:

- *T1 ("Direct" messaging)*– The videos were directly served to a large number of Facebook users.
- *T2 ("Friends" messaging*)– The videos encouraged viewers to share resources about vaccines with friends (see script

in Online Appendix I.A). Individuals could easily share the ad with others, and those interested in learning more could click on a link to the study website, where they could watch and share videos about vaccination.

- *T3 (US only) ("Gossips" messaging*)– Facebook users received ads which encouraged them to ask their most influential friends to encourage friends to get vaccinated. This variation on T2 was more novel and rooted in our prior work on childhood vaccination in India, where we found that individuals who are nominated by their social network to be locally influential are more effective immunization ambassadors than randomly selected people (Banerjee et al. 2019).

In the US (France), randomization was done at the county (ZIP & EPCI) level and stratified by state (region), political leaning (population) and baseline vaccination rates (idem). 1,397 counties were randomized in the US experiment, and 1,030 EPCI and 251 postal codes were included in France.

B. Implementation & Take-up

The Facebook campaigns were implemented between December 22, 2021 and January 27, 2022 in the US and February 3rd, 2022 – March 17, 2022 for France[1]. The campaigns reached a very large audience: 17.8 million distinct users in the US and 11.5 million in France. Moreover, Facebook users did watch the videos served to them about vaccination: the fraction of 3-second and 50% plays (45-50% and 3-5% respectively for the US and 52% and 9-10% respectively for France) indicate a large engagement with the material compared to industry standards for video ad campaigns[2]. These watch rates are also higher than those in the Facebook campaigns which successfully discouraged people from traveling during Thanksgiving and Christmas (Breza et al. 2021). However, the follow-through rates were low in both countries. In France (US), only 1.4% (0.6%) of users clicked on the ads to visit the study website. And only 5 (2) website visitors signed up to be a "vaccine ambassador" in the US (France). Thus, *prima facie*, there is little evidence that the strategy was successful in motivating people to share resources or encourage others to get vaccinated.

[1] Due to a payment problem with the FB ad credits, ads were offline from 18 Feb to 28 Feb, and again from March 9 through March 13.

[2] The average Facebook video in December and January 2021 received 3-second views from 40-45% of users according to https://www.socialstatus.io/insights/social-media-benchmarks/facebook-video-view-rate-benchmark/

III. Analysis

To estimate the week-by-week effects of the U.S. Facebook campaigns on the number of vaccinations reported in each county, we estimate the following regression:

$$(1) \quad \text{asinh}\,(y_{it}) = \Sigma_t\, \beta_{1t}\, D_i \times W_t + \Sigma_t\, \beta_{2t} F_i \times W_t + \Sigma_t\, \beta_{3t}\, G_i \times W_t \; Controls_i + W_t + Strata_i + \varepsilon_{it}$$

where D, F, G are treatment indicators, W_t denotes week t and y_{it} is the number of new COVID-19 vaccinations in county i during week t. In different specifications, y_{it} is the first dose of vaccine, second dose of vaccine, booster shot, or a sum of all three.

To analyze the France campaign, we run a similar regression, where t denotes two-week periods rather than a one-week period. This two-week aggregation is done to reduce the number of zeros in the outcome distribution[3]. $Controls_i$ are area-level control variables that were LASSO-selected among a pool of demographic (US) or socio-economic (France) characteristics[4]. The selected controls include population, baseline vaccination rates, and urban/rural status or GOP win margin in the 2020 presidential election (US). We use the hyperbolic sine transformation because the outcome distributions are approximately log-normal, with some areas reporting zero new vaccinations. In addition to these week-by-week regressions, we also estimate specifications which aggregate weeks which occurred before, during, and after the campaigns (see Online Appendix II.B). All specifications point to a null effect of treatment.

IV. Results

A. Effects of the Interventions

As demonstrated in Online Appendix II.A, the randomization was generally effective at creating comparable groups. Figure 1 presents the main results for the US by showing the weekly treatment effects on new first dose vaccinations. The coefficients are very small and significantly indistinguishable from zero in each of the Direct (2a), Friends (2b) or Gossips (2c) campaigns. The results are very similar for the France campaigns (see Supplementary Figures 2a-2b).

Table 1 shows the overall impact of all three campaigns during and after the intervention period in the US. We find that during the campaign, the estimated coefficient of the Direct campaign is -0.023 (SE 0.040 95% CI -0.10 +0.055) and -0.017 (SE 0.037, 95% CI -

3 Moving from a week-level aggregation to a 2 weeks-level aggregation reduces the share of zeros from 34.3% to 20.6%, and it is further reduced to 15.2% when using a 3 weeks-level aggregation. The results remain similar in each of these week-level aggregations and are presented in Online Appendix II.C.

4 US: ACS 2019 data & France: INSEE data.

0.090 +0.056) after the campaign. Since these are in percentage terms, we can rule out even very small impacts: if the campaign had increased the number of vaccinations given during the intervention period by 5.5% in every county, then the *change* in county-level vaccination rates would have increased by 0.13 pp on average (on a basis of +2.34 pp, experienced by the control group over the treatment period). As shown by the estimates in Online Appendix Supp. Table 3, we can also rule out similarly small effects in France.

Our ability to rule out such small effects despite the large engagement on Facebook relative to industry standards provides strong evidence in favor of a null effect. It is not that people did not watch the vaccination-related content. Rather, they *chose* not to follow up on the content.

In our Online Appendix II, we show robustness of these results to 1) second doses, boosters or any vaccine (US), 2) pooling together the Friends and Gossips campaigns, 3) interactions with urban/rural status, political leaning or baseline vaccination rates, 4) reweighting pre-trends in Figure 2, 5) using a negative binomial specification for France, and 6) using a three-week aggregation for France.

V. Discussion

Neither a direct outreach campaign by doctors, nor the two campaigns to activate local social networks, were effective in increasing COVID-19 vaccinations during the winter of 2021-2022 at the height of the Omicron wave. One possible explanation is that opinions about the vaccines were already firmly held by most people, and few people remained who could be nudged. In France, an additional factor is that strong incentives to get vaccinated were introduced during the summer of 2021, making life very difficult for unvaccinated people. Thus, despite new studies on the effectiveness of vaccination and boosters, the vaccine “hesitancy” had vanished: there were only the vaccinated and the vaccine resistants. It likely did not help that people’s opinions may have become more firmly entrenched as COVID-19 vaccines became more politicized over the course of 2020-2021. Lastly, people’s calculations of marginal benefits to marginal costs may have shifted as Omicron became the prevalent variant; Omicron appears to be less likely to result in hospitalization than the Delta variant, and also seems to be able to evade vaccines more easily for infection (Sheikh et al. 2022). These results suggest that different strategies need to be mobilized for vaccination rates to progress in places where they remain low.

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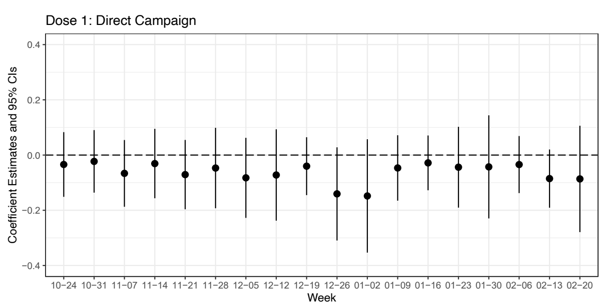
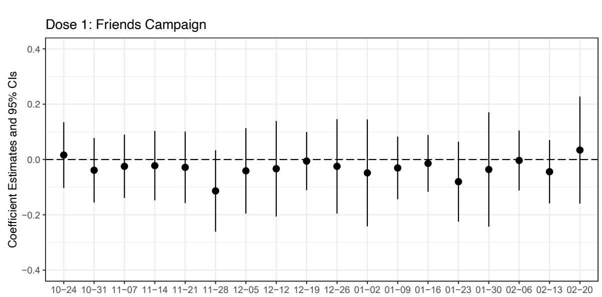
Figures and Tables

Panel A:



Panel B:



Panel C:

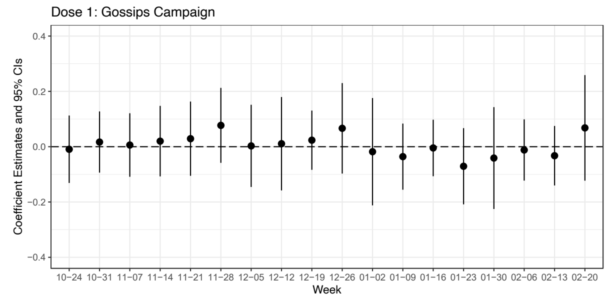


FIGURE 1: WEEK-BY-WEEK IMPACT OF THE US CAMPAIGNS ON 1ST DOSE VACCINATION

Note: This figure presents the estimated coefficients $\beta_{1,t}$ (panel A), $\beta_{2,t}$ (panel B) and $\beta_{3,t}$ (panel C) from Equation (1) for the US with 95% confidence intervals, using the number of first dose vaccinations in a week as the outcome variable. The red dotted vertical lines indicate the beginning and the end of the campaign. The regression includes week and strata fixed effects, as well as LASSO-selected controls from a pool of county-level demographics. Standard errors have been clustered at the county level.

TABLE 1: EFFECTS OF FACEBOOK CAMPAIGNS ON NEW COVID-19 DOSE 1 VACCINATIONS, US

	(1)	(2)
	Asinh(New Dose 1)	Log(New Dose 1 + 1)
Direct Campaign		
Direct x during	-0.023	-0.017
	(0.040)	(0.037)
	$p = 0.560$, $RI\ p = 0.726$	$p = 0.641$, $RI\ p = 0.726$
Direct x post	-0.017	-0.008
	(0.043)	(0.038)
	$p = 0.696$, $RI\ p = 0.61$	$p = 0.832$, $RI\ p = 0.61$
Friends Campaign		
Friends x during	-0.007	-0.006
	(0.038)	(0.035)
	$p = 0.863$, $RI\ p = 0.57$	$p = 0.875$, $RI\ p = 0.57$
Friends x post	0.028	0.038
	(0.045)	(0.040)
	$p = 0.533$, $RI\ p = 0.115$	$p = 0.333$, $RI\ p = 0.115$
Gossips Campaign		
Gossips x during	-0.037	-0.034
	(0.036)	(0.034)
	$p = 0.310$, $RI\ p = 0.892$	$p = 0.309$, $RI\ p = 0.892$
Gossips x post	-0.012	-0.011
	(0.044)	(0.039)
	$p = 0.788$, $RI\ p = 0.644$	$p = 0.777$, $RI\ p = 0.644$
Observations	21834	21834
Avg % with Dose 1 at Baseline	51.3	51.3
Week Fixed Effects	Yes	Yes
Strata Fixed Effects	Yes	Yes

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

Note: This table shows the effect of the campaigns on the inverse hyperbolic sine (Column 1) or logarithm (Column 2) of new weekly first doses. Standard errors are reported in parentheses and we provide standard p-values as well as p-values from randomization. Regressions include week and strata fixed effects, as well as LASSO-selected controls from a pool of county-level characteristics. Standard errors are clustered at the county level. The relevant regression is provided as Equation (2) in Online Appendix II.B.