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The Impact of Large-Scale Social Media Advertising Campaigns on COVID-19 Vaccination: Evidence from Two Randomized Controlled Trials†

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Despite widespread availability of COVID-19 vaccination in wealthy countries, many people remain unvaccinated. In the United States, 72.9 percent of adults were fully vaccinated (with two doses) and only 13.5 percent were up to date with boosters as of December 2022, according to the Centers for Disease Control and Prevention (2022). 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 for public health messaging, 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 United States and Europe (Altman 2021; Lévy, Lancrey-Javal, and Prunier 2019). However, some people may not trust experts and may react better to laypeople who are more similar to them and whose experience may be more relevant (see Alsan and Eichmeyer 2021 for an example in the context of flu). Therefore, activating local social networks could be another, potentially complementary,

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strategy to promote vaccination (Alatas et al. 2019; Chevrel and Éveillard 2021).

In previous work, some of the authors found that both of these approaches could be promising. First, we found that video messages sent by physicians and nurses increased COVID-19 knowledge and willingness to pay for masks (Alsan et al. 2021; Torres et al. 2021). In addition, videos sent to millions of Facebook users in fall 2020 to encourage them not to travel for Thanksgiving and Christmas led to a significant decrease in distance traveled and subsequent COVID-19 infections (Breza et al. 2021). Third, Banerjee et al. (2019) found that the most effective way to identify locally influential people was to simply ask members of the social network who is best placed to circulate a piece of information. Then, in villages where such people were reminded to encourage friends and acquaintances to get vaccinated, immunization rates 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 too hardened to change? We address this gap by conducting two large-scale randomized controlled trials in the United States and in France.

In both countries, physicians and nurses recorded short videos to promote COVID-19 vaccination and address common doubts about the vaccine. 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 strategy, including whether the ads encouraged users to leverage their social networks.

Despite the ads reaching over 29 million distinct Facebook users and achieving high engagement metrics, we fail to reject the null of no impact of any of the treatments on any of the outcomes (first, second, and booster shots in the United States, 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.

I. Study Design

A. *Treatments and Randomization*

Facebook users received short ($\approx$ 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:

- *T*1 (*"Direct" messaging*)—The videos were directly served to a large number of Facebook users in sponsored ads.
- *T*2 (*"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.
- *T*3 (*US only*) (*"Gossips" messaging*)—Facebook users received ads that 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 United States (France), randomization was done at the county (postal code and établissement public de coopération intercommunale (EPCI)) level and stratified by state (region), political leaning (population), and baseline vaccination rates (idem). In the US experiment, 1,397 counties were randomized, and in France, 1,030 EPCI and 251 postal codes were included.

B. *Implementation and Take-up*

The Facebook campaigns were implemented between December 22, 2021, and January 27, 2022, in the United States and between February

3, 2022, and March 17, 2022, for France.[1] The campaigns reached a very large audience: 17.8 million distinct users in the United States and 11.5 million in France. Moreover, Facebook users did watch the videos served to them about vaccination: the fraction of three-second and 50 percent plays (45–50 percent and 3–5 percent, respectively, for the United States, and 52 percent and 9–10 percent, 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 that successfully discouraged people from traveling during Thanksgiving and Christmas (Breza et al. 2021). However, the follow-through rates were low in both countries. In the United States (France), only 0.6 percent (1.4 percent) of users clicked on the ads to visit the study website. And only five (two) website visitors signed up to be a "vaccine ambassador" in the United States (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.

II. Analysis

To estimate week-by-week effects of the US campaigns on new vaccinations in each county, we estimate the following regression:

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

where $D, F,$ and 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, the second dose, the booster shot, or a sum of all three. We use the hyperbolic sine transformation because outcome distributions are approximately log-normal, with some areas reporting zero new vaccinations in France. We also estimate $\log(y_{it} + 1)$, as well as negative binomial regressions in France.

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 (United States) or socioeconomic (France) characteristics.[4] The selected controls include population, baseline vaccination rates, and urban/rural status or Republican party win margin in the 2020 presidential election (United States). In addition to these week-by-week regressions, we also estimate specifications that aggregate weeks that occurred before, during, and after the campaigns (see Table 1 and online Appendix II.B). All specifications point to a null effect of treatment.

III. Results

A. *Effects of the Interventions*

As shown in online Appendix II.A, the randomization generally created comparable groups effectively. Figure 1 presents the main US results of weekly treatment effects on new first-dose vaccinations. The coefficients are very small and statistically 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 presents the impact of all three campaigns during and after the intervention period in the United States. The estimated coefficient of the Direct campaign is −0.023 (SE: 0.040, 95 percent confidence interval: −0.10, +0.055) during and −0.017 (SE: 0.043, 95 percent

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

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

[3] Moving from a week-level aggregation to a 2-week-level aggregation reduces the share of zeros from 30.6 percent to 20.6 percent, and it is further reduced to 15.2 percent when using a 3-week-level aggregation. The results remain similar in each of these specifications, and results are presented in online Appendix II.C.

[4] United States: American Community Survey (US Census Bureau 2019) data and France: INSEE data.

Table 1—Effects of Facebook Campaigns on New COVID-19 Dose 1 Vaccinations, United States

	asinh(new dose 1) (1)	log(new dose 1 + 1) (2)
Direct campaign		
Direct × During	−0.023	−0.017
	(0.040)	(0.037)
	$p = 0.560$, $RI\ p = 0.769$	$p = 0.641$, $RI\ p = 0.729$
Direct × Post	−0.017	−0.008
	(0.043)	(0.038)
	$p = 0.696$, $RI\ p = 0.695$	$p = 0.832$, $RI\ p = 0.607$
Friends campagin		
Friends × During	−0.007	−0.006
	(0.038)	(0.035)
	$p = 0.863$, $RI\ p = 0.594$	$p = 0.875$, $RI\ p = 0.589$
Friends × Post	0.028	0.038
	(0.045)	(0.040)
	$p = 0.533$, $RI\ p = 0.188$	$p = 0.333$, $RI\ p = 0.089$
Gossips campaign		
Gossips × During	−0.037	−0.034
	(0.036)	(0.034)
	$p = 0.310$, $RI\ p = 0.894$	$p = 0.309$, $RI\ p = 0.899$
Gossips × Post	−0.012	−0.011
	(0.044)	(0.039)
	$p = 0.788$, $RI\ p = 0.639$	$p = 0.777$, $RI\ p = 0.641$
Observations	21,834	21,834
Average percent with dose 1 at baseline	51.3	51.3
Week fixed effects	Yes	Yes
Strata fixed effects	Yes	Yes

Notes: 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 inference (RI). 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.

confidence interval: −0.10, +0.067) after the campaign. Since these are in percentage terms, we can rule out very small impacts: if the campaign had increased the number of vaccinations given during the intervention period by 5.5 percent 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). The same logic applied to the Friends and Gossips campaigns bounds their impact at 0.16 pp and 0.08 pp, respectively. As shown by the estimates in online Appendix Supplementary Table 3, we can also rule out similarly small effects in France (0.02 pp for both the Direct and Friends campaigns).

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 online Appendix II.B and II.C, we show robustness of this null effect to (i) considering second doses, boosters, or any vaccine (United States); (ii) interactions with urban/rural status, political leaning, or baseline vaccination rates; (iii) quantile regressions; (iv) using a three-week aggregation for France; (v) using a negative binomial specification for France; (vi) reweighting pretrends; and (vii) pooling together the Friends and Gossips campaigns.

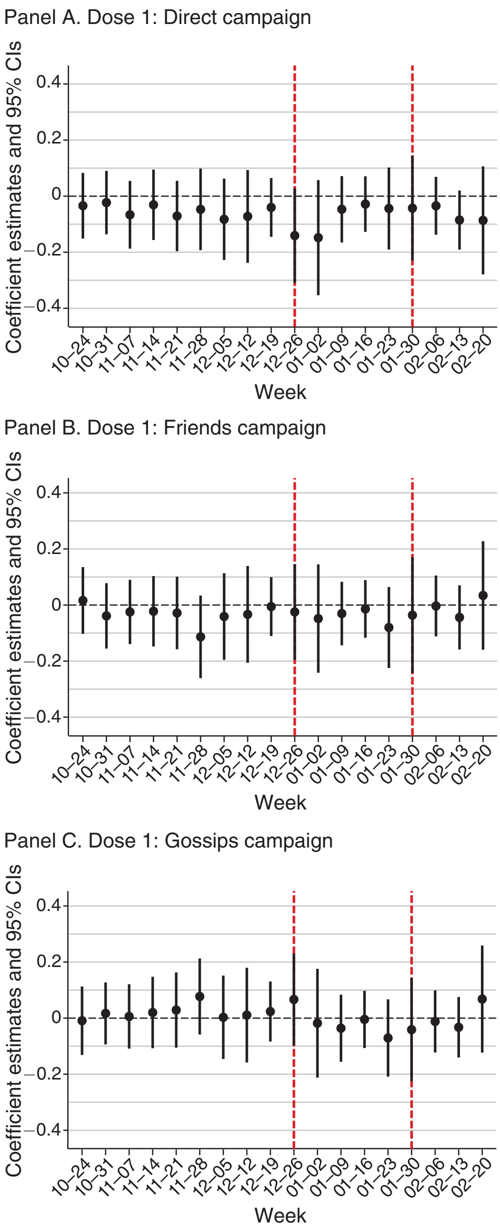

Figure 1. Week-by-Week Impact of the US Campaigns on First-Dose Vaccination

Notes: 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 United States with 95 percent 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. These observations come from the end of 2021 and beginning of 2022. 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.

IV. 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, vaccine "hesitancy" had vanished: there were only the vaccinated and the vaccine resistant. 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 it 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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