The limits and perils of gentle communication against vaccine hesitancy: an informational trial*

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Abstract

Abstract: As populations age, healthcare systems face rising costs from vaccine-preventable diseases. To address vaccine hesitancy, health authorities increasingly recommend gentle communication over paternalistic approaches. We run a factorial survey experiment on a representative sample of 12,000 Italians aged 40+ to test whether gentle communication outperforms traditional messaging and other behavioral nudges in a cost-effective video campaign for the flu vaccine. While perceptions of informants improve, willingness to vaccinate falls by 7.4% (3 p.p.), and uptake remains unchanged. Causal forests show that this mismatch reflects heterogeneous effects across non-overlapping groups rather than cognitive resistance.

JEL: I18, D04, D91

Keywords: information framing, vaccinations, public health

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1 Introduction

As the global population rapidly ages, preventing viral diseases that drive morbidity, mortality, and high healthcare demand among older adults is becoming a priority of economic and public health policy (United Nations, 2024). At the same time, future pandemics represent an ongoing global risk, compounding the structural pressures that ageing imposes on health systems, and already amplified by COVID-19 (Global Preparedness Monitoring Board, 2024; Yuan et al., 2021; Lekamwasam and Lekamwasam, 2020). Vaccination remains the primary tool for mitigating both the spread of viral infections and the severe complications that burden hospitals and primary care facilities.[1] However, the pandemic has exacerbated pre-existing challenges to vaccine uptake by amplifying misinformation, strengthening vaccine hesitancy, and undermining trust in health authorities (Angerer et al., 2023; Larson et al., 2022; van Bavel et al., 2020).

In this context, designing cost-effective and scalable communication strategies to address vaccine hesitancy has become a key challenge. Indeed, since COVID-19, many countries have increasingly relied on video-based informational campaigns, which can be delivered at low marginal cost to large masses through both traditional and digital media (ECDC, 2024b; Denison et al., 2023).[2] In parallel, global and national policy recommendations — including the WHO framework on Integrated People-Centred Health Services (IPCHS) — have promoted "gentle communication" techniques to encourage vaccination uptake by fostering patients' self-efficacy and active participation, shifting away from unidirectional and paternalistic communication models (WHO, 2016; Robert, 2013). These approaches, however, require expensive training and must be implemented through time-consuming in-person interactions that are difficult to scale precisely in the overburdened health systems most in need of them (Miller and Rollnick, 2009; ECDC, 2024b). As a result, more recent recommendations increasingly include similar communication principles for image-based and digital formats, such as video campaigns (ECDC, 2024b; The Ad Council, 2021; Tait et al., 2025).

In this paper, we conduct a survey experiment to investigate whether gentle communication techniques are more effective in increasing flu vaccine uptake than more traditional, unidirectional forms of framing, in the context of video informational campaigns. Among gentle communication

[1]During the COVID-19 pandemic, vaccines also spilled over to improve mental health, which constituted an additional public health concern (Bagues and Dimitrova, 2025).

[2]A greater use of video campaigns was recommended already before the pandemic (ECDC, 2017), although empirical evidence of their effectiveness is mixed. Video messages containing different nudges have successfully improved preventive health behaviors before (Alsan and Eichmeyer, 2024) and during COVID-19 in the US (Breza et al., 2021), and in India (Banerjee et al., 2020b; Armand et al., 2024), whereas post-pandemic RCTs in France and the US find null effects from previously effective nudges (Ho et al., 2023).

techniques, we focus on Motivational Interviewing (henceforth MI), as it is widely studied and implemented globally, and for the availability of psychometrically validated scales to assess the compliance of video scripts to MI.[3] Our treatment is delivered through a video (approximately 100 seconds long) covering the safety of the flu vaccine, debunking common concerns about adverse effects, and describing the magnitude and frequency of possible seasonal flu complications for older individuals, in line with most recent content recommendations (ECDC, 2024b). Under MI, the information is conveyed through a dialogue between an informant and a patient, whereas under unidirectional communication (UD), the informant speaks directly to the camera. We adopt a factorial design to test MI against unidirectional communication techniques and its possible interaction with more traditional recommended nudges: (i) representing the informant as a medical doctor (*vs* a layperson); (ii) gender concordance between the informant and the patient in the video – whose gender is always the same as the study participant's (e.g., Alsan and Eichmeyer, 2024; Greene et al., 2023). We further stratify participants by gender, to properly account for possible heterogeneity in response between men and women (e.g., Angerer et al., 2024).[4]

The survey experiment was conducted in autumn 2023 on a sample of approximately 12000 Italian panelists over age 40, stratified by gender, age class, education, region of residence, and urban residence, with weights that resemble the distributions in the 2021 census. While the majority of subjects were surveyed online, older participants underwent in-person interviews at home to prevent selection bias resulting from health status or limited familiarity with technology.[5] Italy is an ideal setting for several reasons. It is the second-oldest country worldwide: demographic projections place all regions except Sub-Saharan Africa on the trajectory to reach the Italian population distribution within the next three decades (e.g., Navaneetham and Arunachalam, 2023), making Italy an interesting setting to assess policies aimed at older generations. This demographic distribution also makes the seasonal flu one of the first and increasingly common causes of death, along with other respiratory infections preventable with vaccines (Istituto Superiore di Sanità, 2024; ISTAT, 2025).

[3] Examples of MI implementation for different objectives and in different countries can be found in WHO (2017); Dempsey et al. (2018); Gagneur et al. (2018, 2019); Wermers et al. (2021); Labbé et al. (2022); Scales et al. (2023); Cataldi et al. (2022, 2024). More generally, a Google Scholar search (2025-10-05) found 17,100 articles published since 2020 with the term "Motivational Interviewing" in the title.

[4] To clarify this feature of our design further, the gender of the receiver depicted in the video is always the same as the study participant's gender to favour identification. What the gender concordance nudge varies is whether the informant and the receiver (hence the participant) have the same or a different gender.

[5] The most serious complications are already observed after age 50 (Rothberg et al., 2008). Moreover, this set of ages allows us to observe the most fragile population of the elderly along with their children, who are highly involved in their care and support (Brenna, 2021). Representativeness was attained by using census quotas for sampling by age class, educational attainment, and region of residence. Participants were randomized into the 16 cells defined by all 3 nudges using these quotas stratification, on top of the stratification by gender (equal weights). Participants were recruited from several online panels held by our implementing partner *Bilendi & Respondi*. The entire design is described in more detail in Section 3.1.

Despite this, and despite having increased by more than 10 percentage points after the COVID-19 pandemic, flu vaccination coverage remains low for both the general population (23.7%) and the more fragile elderly population above 65 years old (65.3% against a 95% target) (Greco et al., 2021; Istituto Superiore di Sanità, 2024).[6] This initial increase in uptake could be attributed to the fact that, relative to other countries, Italy also suffered a particularly high mortality impact from COVID-19 (Giulietti et al., 2023). The government adopted strong containment measures, for instance by imposing a national lockdown already at the beginning of March 2020. The early impact of COVID-19 also generated a wave of inconsistent communications by health experts on multiple media, which contributed to spreading confusion on the scientific consensus around precautionary health measures (not unlike other European countries, e.g., Bartoš et al., 2022). The government responded by adopting stark unidirectional communications to contrast vaccine hesitancy and citizens' skepticism (Casalegno et al., 2021). A key example was the government's choice to appoint an Army Corps general as the national vaccination campaign's manager, General Figliuolo, whose tone was authoritative, paternalistic, and direct. In particular, his narrative explicitly equated the vaccination campaign to wartime efforts (Nuciari, 2021).

Although these elements suggest gentle communication as an ideal informational strategy, our results highlight worrisome limitations. As a first impact, consistent with theories, MI increases the positive perception of informants, who are seen as more collaborative, considerate, sincere, and trustworthy. In this regard, MI significantly outperforms the other nudges. Yet, participants exposed to MI also decreased their intention to vaccinate against the flu by 2-3 percentage points (a $\approx$ 7.4% decrease). When we ask whether they actually vaccinated 2 to 3 months after treatment, we estimate a precise null effect. Moreover, while this null result refers to the comparison of MI and unidirectional communication – our research focus – we also observe that 85% of participants did not change their vaccination behavior relative to the previous year. Out of the 15% who did change their behavior, approximately two-thirds passed from vaccinating in 2022 to not vaccinating in 2023, after our experiment, regardless of whether they were exposed to MI or unidirectional communication. This suggests that null estimates speak not only about the absence of different impacts of these two communication techniques but also about their shared ineffectiveness in raising vaccination uptake.

Similar inconsistencies between improved perceptions and unchanged behaviours have also been found in studies focusing on other informational interventions on vaccines as well as other domains,

[6] In our sample, that includes only age classes above 40 weighted by their relative size in 2021 census data, the self-reported pre-treatment coverage is 40.6%. Restricting to individuals over 65, it is 68%.

suggesting wide implications from a common mechanism of informational absorption (Angerer et al., 2024; Kerr et al., 2022; Barrera et al., 2020). We contribute by investigating deeper into the dynamics behind this result. Specifically, we estimate causal forests to predict individual causal effects and understand which subsamples drive changes in our different outcomes, and complement them with robustness checks to show that MI does not impact other outcomes, such as knowledge of vaccines or distrust of science. Causal forests reveal that participants who improved their perception of the informant never experienced a significant behavioral effect from MI. Rather than a blocked path from thought processes to behaviours, this indicates separate, non-overlapping clusters of individuals with completely different reactions. Indeed, we generally find that the null behavioral result hides a heterogeneity that underlines important limitations of applying MI to video campaigns. The vast majority of our respondents experience a null effect. Within the 3% that experience a significant effect (6% adopting a 90% significance level), more than half experience a negative effect.

While they appear small, these low percentages correspond to more than 1 million people in Italy, taking into account the representativeness of our sample (2 million under a 90% significance level). Moreover, the respondents who experienced a negative effect did not have particularly negative views of vaccines before treatment; MI appears to prevent a non-negligible number of potentially compliant individuals from vaccinating, not including potential negative spillovers on personal networks.[7] MI does not interact consistently with other nudges. These, therefore, cannot be used to mitigate the negative effects in specific subgroups.[8] Causal forests also allow us to draw another important conclusion. Positive and significant behavioral effects from MI are driven by responders who are older and report a worse health status at baseline. Since most existing studies that find positive effects from MI focus on convenience samples selected by the presence of a health condition, we conjecture that those findings are not generalizable to the full population. While MI can be helpful for specific groups who might be more used to interacting with health professionals, it could backfire when addressed to the general population: this suggests caution in pushing gentle communication as a large-scale policy tool and in applying it to videos in order to cut on high training and implementation costs.

More generally, our paper contributes to a growing economic literature on promoting preventive health behaviors through informational nudges, recently reviewed by Liu et al. (2024), by assessing

[7] Although most research in the health domain focuses on positive spillovers, including from and on vaccination behaviour (for example, see Humlum et al., 2024; Itaya et al., 2018) and from observing severe cases of COVID-19 and social distancing policies on self-isolation during the pandemic (Bailey et al., 2024).

[8] Due to the small numbers, we cannot conclude with certainty that negative effects would be more numerous than positive effects in the general population. Nevertheless, we can predict that negative effects would involve a large number of potentially compliant people, which is not ideal when considering that most respondents experience a null effect.

the lack of improvement from adopting recommended gentle communication techniques, and showing the absence of significant interactions with other traditional nudges.[9] We also contribute by focusing specifically on video campaigns: despite their increasing application, not many studies assessed their effects: notably, other nudges were studied by Alsan and Eichmeyer (2024); Breza et al. (2021); Ho et al. (2023). Null behavioural results or unexpected backfiring have also been found by studies on different informational interventions. Besides the aforementioned Angerer et al. (2024) and Kerr et al. (2022), Milkman et al. (2011) find that in the United States, nudges demanding interaction from the information recipient in writing down flu vaccination appointments (delivered via text message) are less effective than traditional reminders (Milkman et al., 2021). For written information, Dominici and Dahlström (2025) find that lowly educated parents in Sweden respond to framed leaflets on the HPV vaccine, increasing uptake for scientific framing and decreasing it for emotional negative framing. Like gentle communication, emotional framing is advocated by patient associations and several health authorities, but can result in backfiring. Berger et al. (2025) tested in-use fact-checking techniques on COVID-19 and nutrition misinformation from Facebook in a survey experiment, finding that they primarily affect the specific piece of information targeted by the intervention. Moreover, fact-checking also fails to offset the negative effects of exposure to fake news, as required by their experimental design.

There is a vast public health literature on the benefits of doctor-patient gender concordance in various in-person settings (e.g., Kerssens et al., 1997; Franks and Bertakis, 2003; Nolen et al., 2016; Tobler et al., 2016), to which we contribute by assessing the case of video informational campaigns. Another relevant nudge, tested also in video format, is race concordance (adopted and reviewed by Alsan and Eichmeyer (2024) and Alsan et al. (2019)). Similarly, Armand et al. (2024) look at religious faith concordance in India. Both race and religion are not salient in the Italian context, where the population – especially for older cohorts – is generally homogeneous in both these dimensions. However, as noted by Street et al. (2008), concordance nudges can be considered as being part of a more general mechanism of recognizing one's own identity in the informant. In this regard, we contribute by showing that both the doctor and the MI nudges vary the perceived social distance between the expert and the information recipient: in the case of the doctor nudge, our results go in the opposite direction of Alsan and Eichmeyer (2024), who focused on the specific target group of hesitant black men in the US. These distinctions become particularly relevant in the aftermath of the COVID-19 pandemic, which widened the perceived social distance from experts

[9] Many studies on nudges focus on developing countries that are very different from our setting, e.g. Armand et al. (2024); Banerjee et al. (2022, 2020a) for India, Alatas et al. (2024) for Indonesia, and Offer-Westort et al. (2024) for Kenya and Nigeria.

(Eichengreen et al., 2021).

The rest of the paper proceeds as follows. Section 2 describes the background, namely the Italian setting and our MI treatment. Section 3 introduces our experimental design and estimation methods. Section 4 presents and discusses the results and the mechanisms. Section 5 concludes the paper.

2 Background

2.1 The Italian setting

Influenza vaccination coverage among older adults at risk (over 65) in Italy was 65.3% in 2022–23, according to administrative records from the Istituto Superiore di Sanità (2024). Our sample, which includes two extra regions relative to these statistics, including Lombardy, that has a particularly high proportion of urban, highly educated population, displays a slightly higher rate of 68.3% for the same age group. National coverage has been declining in recent years, after an initial spike in the aftermath of the COVID-19 pandemic. Importantly, the seasonal flu vaccine campaign we focus on and the COVID-19 booster campaigns are typically run together.

While administrative records do not allow direct cross-country comparisons, survey data show that Italian uptake in this age group was close to the EU average at the time of our study (ECDC, 2024a), and that the downward trend is shared across Europe. Italy followed similar patterns before the COVID-19 pandemic (Mereckiene et al., 2018), and during the pandemic itself, despite being severely affected in terms of mortality due to its older demographic profile, COVID-19 vaccine uptake remained broadly aligned with the EU average (OECD, 2023). By 2022, however, Italy's healthcare expenditure stood at 9.4% of GDP—below the EU average of 11%, and was characterized by a relatively higher share of out-of-pocket spending (OECD, 2023). The decline in influenza coverage is also associated with the shrinking density of general practitioners (GPs), who are the primary source of information and encouragement to get the vaccine (Domnich et al., 2024). In this context, Italy's relatively low health expenditures further underscore the importance of cost-effective informational strategies that do not depend exclusively on direct doctor–patient interactions.

When it comes to trust in science, Italy broadly reflects average European patterns. Italians are only slightly above the EU average in endorsing health-related conspiracy theories (approximately 40% versus 35%), including beliefs that cancer cures are concealed for commercial gain or that viruses are artificially created in laboratories to restrict individual freedoms (European Commission and Innovation, 2025). In general, these views are most prevalent among older individuals and those with lower educational attainment, two characteristics that are more common in Italy relative to EU averages: their higher presence could thus reflect demographic characteristics that, in turn, represent the likely future situation of many Western countries.

2.2 Gentle Communication as Motivational Interviewing

The specific gentle communication technique we adopt is Motivational Interviewing (henceforth MI), because of the aforementioned large use in existing campaigns, large interest in the academic community, and the existance of psychometric scales to evaluate Motivational Interviewing contents. MI comprises codified communication techniques used in direct communications between health professionals and patients to reduce distrust toward preventive healthcare measures. It was introduced in the early 1990s by Miller and Rollnick (1991), initially to address tobacco addiction: it is now a core component of the WHO IPCHS framework, recognized as one of the main "gentle communication" tools in the health domain. It comprises four core elements (Miller and Rollnick, 2013):

1. **Open-ended questions:** patients freely describe their worries and their experiences;
2. **Affirmation:** acknowledging the patient's concerns;
3. **Reflective listening:** expressing empathy and understanding for the feelings verbalized by the patient;
4. **Summary:** summarizing the conversation to allow clarification of possible misinformation received by patients. A motivational interviewer avoids discrepancy and conflict with patients and recognizes their feelings in a non-judgmental way.

MI communication style has proven highly effective in improving health decisions in numerous psychological and medical trials, including adherence to therapy in chronic conditions (Papus et al., 2022), self-medication in patients with diabetes mellitus (Lestari et al., 2021), prevention of dental caries (Colvara et al., 2021), as well as other conditions (Frost et al., 2018). Recent studies have assessed the merits of MI in vaccination campaigns: Gagneur et al. (2018) finds that women in maternity wards treated with MI were more likely to accept childhood vaccinations, whereas

Dempsey et al. (2018) and Reno et al. (2018) improved HPV vaccine acceptance among vaccine-hesitant parents of teenagers. On the other hand, MI requires extensive training by practitioners (Miller and Rollnick, 2009), making some researchers question its application in the face of the large variability in improvement shown for some specific health conditions (e.g., see review studies focused on cardiovascular disease and obesity (Mifsud et al., 2020; Michalopoulou et al., 2022)). One possible solution to cut policy implementation costs is to create a standardized information-framing communication that uses MI strategies without the need to engage in counseling practice. Some efforts in this direction were made by using positive language, acknowledging common concerns and highlighting patients' self-efficacy in passive video campaigns (e.g., the "We can do this" US campaign for COVID vaccines The Ad Council, 2021; Denison et al., 2023), and by assessing the use of conversational agents (chatbots) in the context of smoking cessation and adherence to Global Sustainability Goals, with mixed results (He et al., 2022; Leeuwis and He, 2022; Bilancini et al., 2024). These results leave open the question of whether there might be other approaches to implementing MI communication features in the context of vaccination campaigns, thereby improving their effectiveness without increasing their financial and time costs.

To adapt MI to the video format, we applied all four elements to a video script (corresponding to approximately 100 seconds of filming) representing a dialogue between an informant and a receiver (patient). All the scripts translated to English can be read in Section A of the Appendix. The information receiver in the video expresses doubts that are reported consistently in previous survey evidence, whereas the informant listens and answers according to MI techniques.[10] In the UD case, the informant addresses the same doubts by adopting a direct communication style and speaking directly to the camera for the same duration. The UD script was adapted from the MI version by changing the communication style without altering other elements, including wording: it replaces the acknowledgment of the patients' doubts with an emphasis on the incontrovertible facts that the patient should listen to. After preliminary drafting, an independent team of psychology researchers from the University of Florence verified the adhesion to the MI communication style for the MI scripts and the non-adherence of the UD script using the validated procedure detailed in Moyers et al. (2016).

[10]Following the most common recommendations for this type of interview, we emphasized reflective listening and eliciting patients' willingness to change their minds. Some MI strategies external to the four elements by Miller and Rollnick (2013), such as the readiness scale, were not implemented either because they could not be easily translated in a UD style or because they were too long for the duration of the scripts.

3 Methods

This section details our experimental design and empirical strategy. Both were pre-registered and are publicly available at the AEA RCT registry as AEARCTR-0011862 (Bilancini et al., 2023). Deviations from the Pre-Analysis Plan are listed in Section D in the Appendix.

3.1 Experimental design

We conducted a two-wave survey experiment on a sample of respondents above age 40 from Italy, meant to capture the population segments subject to serious flu complications (starting at 50, Rothberg et al., 2008), and the children of the oldest population segments, typically highly involved with their care (e.g., Brenna, 2021). Study participants were recruited from online panels by the Italian branch of *Bilendi & Respondi*, a multinational market research company specializing in health studies, and are cross-stratified by age class, gender, regional origin, and educational attainment to mirror quotas from the 2021 Italian census. In other words, the distributions of these variables in our sample mirror the actual Italian population. In the first wave of the survey, conducted between mid-September and mid-October 2023, we invited 12000 panelists. Together with our implementing partner, we anticipated that attrition would result in approximately 8000 respondents in the second wave, and ended up with 8310. Section C in the Appendix reports descriptive statistics for the initial sample and balance tests. Importantly, surveys were conducted both online and in person (at the participant's home): the latter was mostly used with older participants, to respect census weights and avoid inducing participation bias correlated with age, health status, or familiarity with technology.

The first wave collected background sociodemographic information and baseline attitudes toward vaccines, science, and medicine. Although educational attainment and pre-treatment flu vaccine uptake vary significantly across age groups, attitudes toward science and vaccines are distributed homogeneously (Section C). Respondents were then exposed to a 100-second informational video on the flu vaccine containing our treatment nudges. Post-treatment, they were asked to rate the video along several dimensions, exposed to attention checks, and asked about their immediate intentions to get the flu vaccine in the upcoming vaccination campaign.[11] The timing of the first survey wave containing the video was chosen to wait until the end of summer vacation sea-

[11] The survey was designed as part of a large multidisciplinary project to inform several empirical studies: we do not make use of all questions.

son – which extends into the first weeks of September, especially for the elderly with nephews – and anticipate the yearly flu vaccination campaign. The height of the campaign typically occurs between mid-October and the Christmas break, with some minimal regional variations. Respondents were then invited for a second wave to collect more outcome variables during the Christmas break (December 20th, 2023 – January 10th, 2024). Both surveys are reported in Section B in the Appendix.

The experiment adopts a $(2 \times 2 \times 2)$ factorial design to test simultaneously the individual and interactive effects of three binary treatments. Indeed, while every video contains the same information on the flu vaccine, video characteristics vary along the following three binary dimensions (nudges):

1. **Motivational interviewing *vs* Uni-directional approach (T_{MI}).** As detailed in Section 2.2, MI ($T_{MI} = 1$) represents a dialogue between informant and receiver carried out with MI techniques, whereas the alternative UD ($T_{MI} = 0$) represents a monologue by the informant.
2. **Informant: medical doctor *vs* layperson (T_{MED}).** The informant is either a medical doctor ($T_{MED} = 1$), depicted in their studio, or a layperson ($T_{MED} = 0$). In the case of UD, the layperson speaks to the camera, whereas under MI, the layperson is a patient sitting in the waiting room of a medical studio.
3. **Gender concordance of informant and receiver (T_G).** Whether the informant and survey respondent are of the same or different gender. Note that, whenever receivers are shown in the video, they always share the same gender of the study participant. In other words, the variation in gender concordance is only between the depicted informant and the receiver in the video. Under UD, the narrating voice reading out loud the questions answered by the informant has the same gender as the informant.

Table 1 summarizes visually the factorial design, reporting the sample sizes corresponding to each resulting cell. In total, our design defines 16 treatment cells. Since the unidirectional videos ($T_{MI} = 0$) only show the informant speaking – whereas the receiver's gender in dialogic videos is always the same as the survey respondent's –, we have a total of 12 videos instead of 16. The videos follow in total 3 scripts, reported in Section A (UD communication, MI for doctor-patient dialogue, MI for patient-patient dialogue). Figure 1 shows a snap-shot of 4 of the videos.

Altogether, we assess the effects on the following outcome variables:

Figure 1: Examples of treatment videos

(A.) $T_{MI} = 1, T_{MED} = 1$, MF

(B.) $T_{MI} = 0, T_{MED} = 1$, F speaker

(C.) $T_{MI} = 1, T_{MED} = 0$, FF

(D.) $T_{MI} = 0, T_{MED} = 0$, M speaker

Notes: the figure shows four examples of previews of our informational videos. The examples include all settings and combinations of treatments T_{MI} and T_{MED}, but only a subset of gender combinations.

1. **Primary outcomes:** self-reported flu vaccination status, long-term (0-1); self-reported intention to vaccinate, short-term (0-1);

2. **Secondary outcomes (to assess mechanisms):**

   - **Positive perception of the informant.** After being exposed to the video, respondents are asked to answer yes/no to whether they found the informant: reliable, collaborative, caring, reassuring, physically attractive, sincere, intelligent. We use each binary indicator independently and construct a "positive perception" score as the sum of all dummies, excluding the one for physical attractiveness, which is not theoretically linked to MI.

   - **Negative perception of the informant.** Same as positive perception with the following items: unreliable, arrogant, careless, disturbing, physically ugly, deceptive, unprepared. Also in this case, we construct the "negative perception" score excluding physical ugliness. Positive and negative items are presented together in random order.

   - **Subjective attention score (1-4 Likert scale)**: we directly ask respondents to report with how much attention they watched the video.

   - **Objective attention score (1-4 sum score)**: after the video, we ask the respondents to indicate whether four statements are reported in the video and construct the score as the number of correct answers. We willingly include statements similar to the video scripts – hence plausibly included if one did not pay attention – but with different meanings. The statements are: (i) The flu vaccine can cause flu-like symptoms (not reported); (ii) This year, the flu virus is particularly aggressive (not reported); (iii) The flu vaccine can cause swelling and soreness at the injection site (reported); (iv) People over 50 years old can experience the flu more severely (reported).

We add a third group of outcome variables measured in the second survey for robustness checks: Self-reported COVID vaccination (0-1), having had medical exams (0-1), how frequently (1-4 Likert scale), distrust of science (1-5 Likert scale), agreement with common misbeliefs over vaccines (1-5 Likert scale), occurrence of a doctor visit (0-1). In particular, COVID vaccination is included to gauge the extent to which our main results are affected by the saliency of the public debate around COVID vaccines, as well as possible spillovers on other vaccines. The use of self-reported outcomes is not new in the literature testing nudges in informational campaigns (e.g., Alsan and Eichmeyer, 2024), and recent evidence comparing them to administrative vaccination records reveals that results based on self-reported measures are consistent with effects on actual vaccination behavior (Dominici and Dahlström, 2025). We further find the inclusion of both a subjective and an objective attention question (administered on separate pages) reassuring, in light of recent evidence showing that the reliability of self-reported measures can be assessed by directly eliciting respondents' perceived reliability (Dohmen and Jagelka, 2024). While we did not pre-register nor ask a self-reported measure of reliability, we do find that neither subjective nor objective attention scores drive our observed results, as shown in Section 3.2. Moreover, Dohmen and Jagelka (2024) identify lack of effort, insufficient incentivization, and limited self-knowledge as key predictors of unreliable self-reports. Regarding effort and incentives, participants were informed at the outset of the first survey that eligibility for a second, paid wave could depend on correctly answering attention questions. Regarding self-knowledge and specific to our outcomes, we elicit respondents' vaccination choice in the previous year and control for it in our regressions, as per our PAP.

The sample sizes reported in Table 1 ensure a power of at least 80% in every comparison between two cells (i.e., when testing the effect of one nudge keeping the other two and respondents' gender fixed). As described in Section 3.2, simultaneous randomization into all three nudges allows estimating all treatment effects and their interaction in a single linear regression model. Coupled with using a wide range of covariates, including baseline vaccination status (in the previous year) and distrust of science and vaccines, it further increases statistical power. Power calculations are reported in Section H in the Appendix. In Section E of the Appendix, we report that attrition between the two survey waves is only affected by exposure to a doctor informant, and report appropriate Lee bounds to verify that selected attrition does not impact our estimates. Morevoer, Section 4 will discuss the robustness of our statistically significant results to corrections for multiple hypothesis testing.

Table 1: ($2 \times 2 \times 2$) Design and sample sizes in second and first survey waves

<table>
<tr><th></th><th></th><th>$T_{MI} = 0$ (UD)</th><th>$T_{MI} = 1$ (MI)</th><th>T_{MED} (Medical doctor)</th></tr>
<tr><td rowspan="4">Gender concordance</td><td rowspan="2">Female subjects</td><td>542 (752)</td><td>515 (750)</td><td>No</td></tr>
<tr><td>515 (751)</td><td>509 (750)</td><td>Yes</td></tr>
<tr><td rowspan="2">Male subjects</td><td>537 (750)</td><td>528 (750)</td><td>No</td></tr>
<tr><td>510 (750)</td><td>502 (750)</td><td>Yes</td></tr>
<tr><td rowspan="4">Gender discordance</td><td rowspan="2">Female subjects</td><td>540 (750)</td><td>520 (750)</td><td>No</td></tr>
<tr><td>508 (750)</td><td>523 (750)</td><td>Yes</td></tr>
<tr><td rowspan="2">Male subjects</td><td>521 (750)</td><td>517 (750)</td><td>No</td></tr>
<tr><td>517 (750)</td><td>506 (751)</td><td>Yes</td></tr>
</table>

Notes: the table shows sample sizes for each cell defined by 3 binary treatments in our factorial design. The first number is the cell sample size at the second wave, for whom we observe self-reported vaccination status 3 months after treatment. The number in parenthesis indicates respondents in the first wave, for whom we observe the intentions to vaccinate against the flu right after being exposed to the video treatment.

3.2 Estimation

Our estimation relies on a combination of ANCOVA regressions to assess average treatment effects, and causal forest models to identify heterogeneous treatment effects.

3.3 ANCOVA regressions

Since respondents are randomized to all three treatments simultaneously, we can estimate all average effects in a single regression model, thereby exploiting the entire sample and maximizing statistical power. Specifically, for each outcome Y_i, we estimate by OLS:

$$Y_i = \alpha + \beta_1 T_{MIi} + \beta_2 T_{Gi} + \beta_3 T_{MEDi} + \boldsymbol{X_i'}\boldsymbol{\gamma} + \varepsilon_i \tag{1}$$

Where i is the individual respondent and standard error are not clustered since respondents are individually randomized into each treatment (Abadie et al., 2023). Vector $\boldsymbol{X}$ contains a wide range of covariates detailing socioeconomic background, self-assessed health status, experience with COVID-19, baseline attitudes toward science and vaccines, and health habits. Detailed definitions and balance tests are reported in Section C in the Appendix.

Equation (1) estimates the average treatment effect of all individual treatments, however, we are also interested in assessing whether the different nudges have interactive effects on our primary outcomes. The proven efficacy of the secondary nudges in some specific setting (as discussed in our literature review) suggests that they could positively moderate the effect of motivational interviewing. Therefore, we complement our analysis with a linear model that interacts all possible combinations of our three nudge treatments up to the triple interaction (T_{MI},T_{MED},T_G). We then compute average marginal effects of MI in each cell of the design.[12]

The choice of the OLS estimator ensures comparability of estimates on individual and interactive effects, where the latter are not easily computed using parametric estimators like Logits, and also allows us to compare results across outcomes on different scales.

[12]Note that we do not interact with the receiver's gender, implying that the highest level interaction effectively exploits the variation across 4 cells from Table 1, i.e., approximately 2080 observations when using second-wave data and 3000 observations when using first-wave data.

3.4 Causal forests

Causal forests are a supervised machine learning method to predict individual causal effects in the presence of individual-level covariates, first proposed by Athey and Imbens (2016). More specifically, they estimate Conditional Average Treatment Effects (CATE). We use them to assess the baseline characteristics of the individuals who respond or do not respond to our main treatment of interest, Motivational Interviewing (T_{MI}).

For a binary treatment, the CATE is defined as $\mathbb{E}[Y_{1i} - Y_{0i} \mid \boldsymbol{X_i} = \boldsymbol{x}]$, where Y_{1i} and Y_{0i} are the potential outcomes under treatment and control, respectively, and $\boldsymbol{X_i}$ are observable characteristics of individual i. Following Athey and Wager (2019), we adopt an "honest" approach: the sample is split into two halves, with one half used to grow a forest of 10,000 trees and the other for estimation. Each tree represents recursive partitions of the covariate space aimed at maximizing treatment effect heterogeneity, with leaves—the smallest partitions—containing at least five observations. The algorithm determines which covariates contribute most to treatment effect heterogeneity using a loss function, and partitions are made sequentially to maximize predictive performance. The second half of the sample is then used to estimate CATEs, based on the covariate importance derived from the forest. For classification, we limit CATE estimation to covariates with above-average importance, although results remain consistent when using all covariates.

For brevity and clarity, we focus on self-reported vaccination (our behavioral outcome) as the vaccination outcome of our causal forest estimation. To report estimation results, we follow two approaches. First, we report the estimates from regressing the individual CATE on individual baseline covariates by OLS. The coefficients show which characteristics moderate the reaction to MI. Second, we partition the sample by whether the CATE is positive and significant, negative and significant, or nondistinguishable from zero: we then count the observations in each partition to assess the extent of effect heterogeneity and compare baseline covariates between the groups. Relative to the first method, this allows us to pin down the characteristics associated with a significant response to MI (positive or negative).

4 Results and Discussion

4.1 Average effects

We first present the average effects of all nudges on both primary and secondary outcomes, estimated by OLS with Equation (1). Table 2 reports estimates for all vaccination outcomes: self-reported flu vaccination status and intention to vaccinate against the flu (estimated both on all respondents and taking into account attrition between the two surveys). All three nudges have a zero effect – with very small and non-significant coefficients on the behavioral outcome, namely the self-reported actual vaccination status. Instead, MI reduces the intention to vaccinate against the flu, which is measured with a direct question after exposing respondents to the nudged video in the first survey. When we restrict this result only to respondents who also participated in the second survey, we find that the negative effect on vaccination intentions has a comparable magnitude relative to the full sample. As discussed in Section 3, the medical doctor nudge T_{MED} caused selected attrition between the first and the second wave. In Section E of the Appendix, we estimate Lee bounds where appropriate to show that results are robust to accounting for this selected attrition, even taking into account potential interactions between the effects of T_{MED} and other treatments.

When considering how nudges impact the informant's perception, a similar discrepancy between thought processes and behavioral outcomes emerges. Despite the precisely estimated zero effect of MI on actual vaccinations, MI significantly increases the positive perception score of the informant by 0.24 on a 0-6 scale (equivalent to 4.7%), more than double the effect of the recommended nudge to identify the informant as a medical doctor (Figure 2).[13] Unsurprisingly, the opposite pattern is found for negative perceptions, which MI reduces more than the doctor nudge. When breaking down the positive perception score into its items (Figure 3), we find that while MI positively impacts all items, the magnitude is mostly driven by perceiving the informant as more collaborative (6.5 percentage points, or 7.7%), considerate (9.9 percentage points, or 12.7%), sincere (3.9 percentage points, or 5.1%), and reassuring (2.1 percentage points, or 2.5%). Relative to other items, these characteristics are theoretically more related to MI: this corroborates our result that MI is effective on thought processes and is also reassuring against possible experimenter demand effects, which should impact all items irrespective of theoretical considerations, since the respondents are not introduced to the concept of MI in the survey. These results are confirmed when looking at the individual items of the negative perception score: for the sake of brevity, they are reported in

[13]Since perception is measured in the first survey, selected attrition is not an issue in this case.

Figure F.5 in the Appendix. Moreover, the absence of significant MI effects on either subjective or objective attention scores suggests that attention does not mediate – hence, explain – the effects of MI on thought processes and perceptions.

Null results are precisely estimated and not economically significant, whereas the statistically significant effects of MI are robust to a Bonferroni correction for multiple hypotheses. In particular, both the negative effects on the intention to vaccinate and the positive effects on perception are robust to correcting for 24 hypotheses, at the 99% significance level. 24 is obtained by multiplying the number of treatments (four, if we include both the gender of the informant and gender concordance) times six, corresponding to the outcomes shown in this section: self-reported vaccination, vaccination intention, two attention scores, and two perception scores.[14] This correction is also extremely conservative, as it disregards correlations between outcomes.

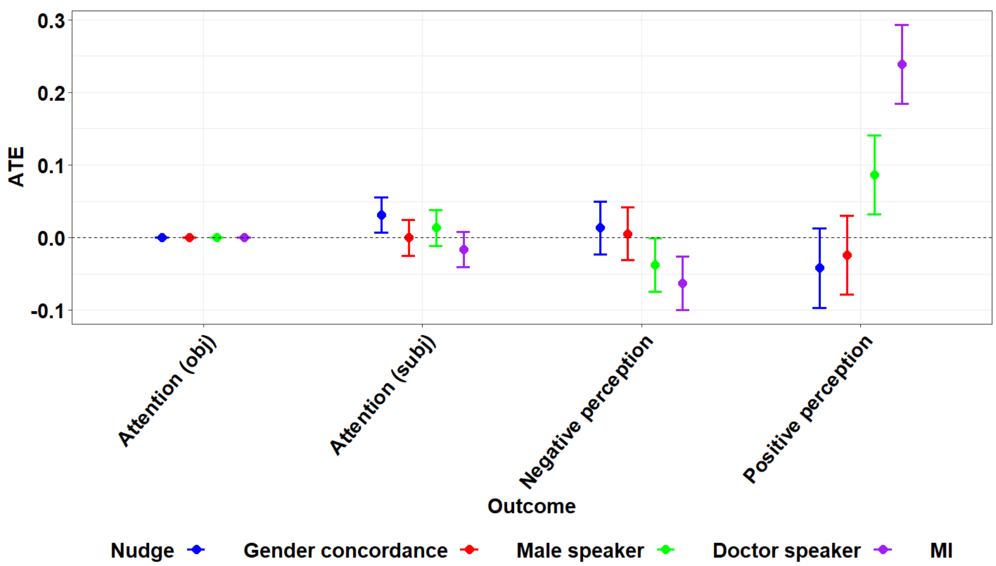
Table 2: Main results: total effect of the three nudges

	Flu vaccination	**Vaccination intention**	**Vaccination intention (2nd wave resp.)**
T_{MI}	-0.0071	-0.0244***	-0.0285***
	(0.0076)	(0.0065)	(0.0078)
T_G	0.0021	0.0025	0.0120
	(0.0076)	(0.0065)	(0.0078)
T_{MED}	-0.0012	-0.0103	-0.0134
	(0.0076)	(0.0065)	(0.0078)
Baseline vaccination rate	0.4059		
Observations	8137	11734	8137

Notes: *p<0.1; **p<0.05; ***p<0.01. The table shows the total effects of all three nudges, estimated by OLS in Equation (1).

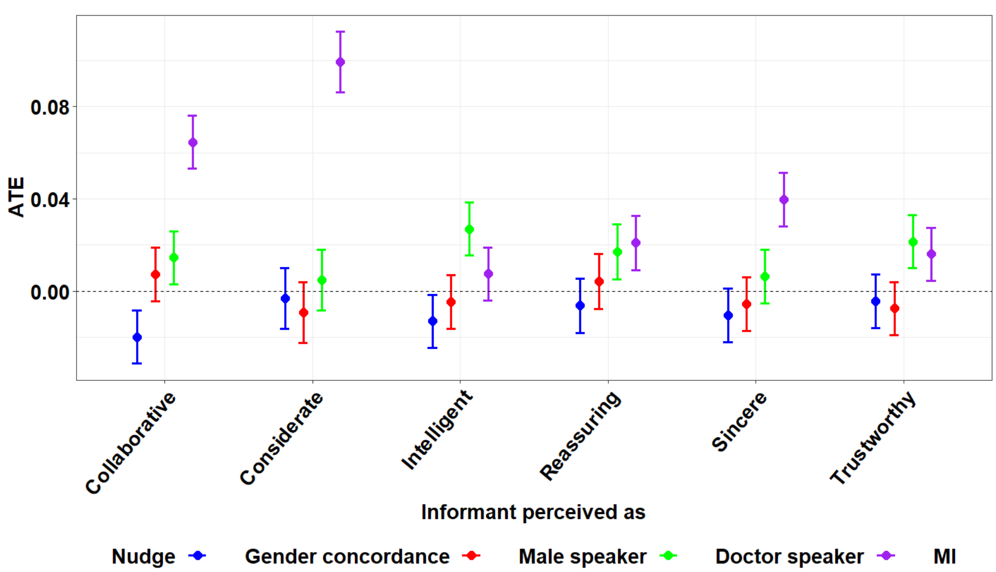
[14] Gender of the informant is also not among our main treatments of interest. Excluding it would leave us with 21 hypotheses to account for.

Figure 2: Mechanisms: attention and informant perception



Notes: the figure shows the ATE estimates and 95% confidence intervals for secondary outcomes, namely an objective attention score, a self-reported (subjective) attention score, and two sum scores for the negative and positive perception of the informant in the video. The detailed description of items used to compute scores is reported in Section 3.

Figure 3: Positive perception score: nudges effect on individual items



Notes: the figure shows the ATE estimates and 95% confidence intervals for all nudges on the individual items used to compute the positive perception score. Respondents are asked to indicate with binary answers how they would describe the informant in the video.

Interactive effects between nudges are not particularly informative. The only relevant pattern we find is that MI has particularly negative effects on all vaccination outcomes relative to direct communication when the informant is a doctor and both the informant and the receiver in the video are men. Estimates of marginal effects are reported in Section F of the Appendix: for the behavioral vaccination outcome and the intention to vaccinate, the magnitude of the negative effect lies between 4 and 5 percentage points. The result is confirmed when looking at COVID-19 vaccination as an additional behavioral outcome. We interpret the consistency of this pattern as evidence that these results are not emerging from spurious correlation but actually speak of the true effects of MI. Moreover, this is consistent with findings that uncover spillovers of pandemics and infectious breakouts on the perception of other vaccines (e.g., Oster, 2018; Soveri et al., 2023), and with the notion that pandemics erode general trust in science through increased misinformation (Eichengreen et al., 2021, 2024). These results are shown in Section G in the Appendix, along with other robustness checks where we also find null effects of MI on other outcomes, namely: doing any medical test, the frequency of doctor visits, their opinion on a third's person (at risk) opportunity to take the flu vaccine, distrust of science and agreement with false statements on vaccines. The last two, in particular, exclude changes in knowledge of vaccines as a mechanism of action of MI.

The next section will examine causal forest results to further identify the respondents who experience significant effects from MI and investigate the discrepancy of effects on perceptions and behavioral outcomes.

4.2 Heterogeneity and mechanisms

The finding that MI worsens intentions to vaccinate but does not impact actual vaccination behavior leaves an open question. One possibility to explain the behavioral null result could be that in the time that passes between the two measurements (approximately 2 months), some respondents might have a positive effect from MI, which could balance the negative effect observed at the first survey on vaccination intentions. Alternatively, vaccination behavior could be fixed and difficult to move, meaning that the vast majority of respondents experience a null effect.

Our causal forest estimates for the flu vaccination outcome allow us to side with the second hypothesis: despite changes in perceptions, most respondents experience a null behavioral effect. In particular, only 246 (2.9%) of second-time respondents experience a significant effect from MI: of these, 133 reduce their likelihood to vaccinate. Another concern could be that direct communication (UD) and MI affect vaccination behavior in ways that we cannot observe without a pure control group in our design. Namely, they could increase vaccination uptake by the same magnitude relative to receiving no communication. Our research question indeed focuses on comparing different nudges in videos rather than giving or not giving information, in line with studies on the effectiveness of MI in in-person communications. Moreover, while we cannot provide causal evidence of this, we can provide suggestive descriptive evidence that a more likely explanation could be that neither UD nor MI causes any behavioral change. Table F.14 in the Appendix shows that regardless of being exposed to MI in the video, very few respondents ($\approx$ 14.7%) changed their vaccination behavior between 2022 (pre-treatment) and 2023 (post-treatment). Moreover, the distribution of respondents across the 4 cells defined by 2022 and 2023 vaccination status are remarkably similar across treatment groups, with a minor increase in those who stopped vaccinating in 2023 in the treatment group.

To further corroborate this finding and exclude other potential causes for our null effect, we conduct a series of robustness checks and show that MI also has a null effect on several alternative outcomes. Results are reported in Section G of the Appendix. These tests also allow us to rule out positive spillovers of our MI intervention on other health decisions. First, one might worry that behavioral outcomes for the flu vaccine are not observed due to a negative reaction to anchoring. As our video focuses on flu, respondents might feel patronized in that particular choice, but might respond with other health behaviors. The main candidate is COVID-19 vaccination, especially due to its salience in the media. We then ask respondents whether they have undergone a series of medical tests and how often. To further rule out that feelings of being patronized drive null effects, we ask the respondents' opinions about a third person's vaccination choices. We present the case of Mario, a 60-year-old man with respiratory failure, and ask respondents what they would recommend doing relative to the flu vaccine. Finally, we measure again distrust of science and agreement with wrong statements on vaccines to measure non-behavioral changes.

Who are those who respond to MI, and how do they differ from the rest of the sample? Table 3 shows, for each baseline covariate, how many standard deviations of difference are found in two types of comparisons: (i) those with positive and significant CATE from MI against those with a non-significant CATE; (ii) those with negative and significant CATE from MI against those with a non-significant CATE. On average, relative to those who experience a null effect, respondents who react negatively have higher education and are more approving of medical research at baseline. Other large differences, albeit not statistically significant, also align with the profile of less vaccine-skeptical individuals: before treatment, they reported having better health, being more trusting of vaccinations, science, and pharmaceutical companies, having more correct beliefs on vaccines, and finding science not too complex. In other words, those impacted negatively were, on average, less vaccine hesitant before treatment, a worrisome result. For those who react positively to MI, we observe the opposite pattern.

MI lessens vaccine hesitancy in a subgroup of respondents who are more vaccine-hesitant at baseline, but it also worsens vaccine hesitancy in a subgroup of people who were initially less vaccine-hesitant. Moreover, those who experience positive effects ($N = 113$, 1.36% of the sample) are less numerous than those who experience negative effects ($N = 133$, 1.60% of the sample). These numbers should be interpreted with caution: we cannot guarantee that the same percentages would apply to the general population. Nevertheless, they also suggest that given our sample's representativeness of the Italian population above 40 years old (≈38 million people), a video campaign adopting MI and without any specific target could drive as many as 608.000 people away from vaccination. While a lower but similar number would be induced to vaccinate, implying an almost neutral overall balance, a worrisome consideration is that those who experience a significant negative effect tend to have no skeptical views of vaccines before treatment, suggesting that they worsened their beliefs (and could potentially have negative spillovers on other untreated individuals). Moreover, the percentages of significant CATEs almost double if one is willing to adopt a 90% significance level: the corresponding comparisons – quantitatively comparable – are reported in Table F.15 in the Appendix.

The results obtained from regressing CATE on baseline covariates provide a different piece of information, as linear regression does not differentiate observation based on their CATEs statistical significance, meaning that OLS coefficients are heavily influenced by the respondents who experience a null effect from MI. Despite this source of attenuation, OLS confirms that higher CATEs are significantly associated with worse health status. Figure 4 also illustrates that on average, higher CATEs are associated with higher age and a series of correlated characteristics: not being employed, and a higher frequency of doctor visits, having vaccinated against the flu in the previous year.

This brings about a fundamental consideration from observing that the entire literature on in-person MI focuses on small convenience samples. These samples are typically selected based on health-related conditions and might respond more positively, as we highlight both in the analysis of significant CATEs and in the following regression analysis. The MI interventions considered in these studies are in-person interactions with longer duration than our videos: our results highlight that cutting training and implementation costs by using video campaigns and directing them at the general population would produce very different and undesired effects that cannot be identified from the currently existing literature.

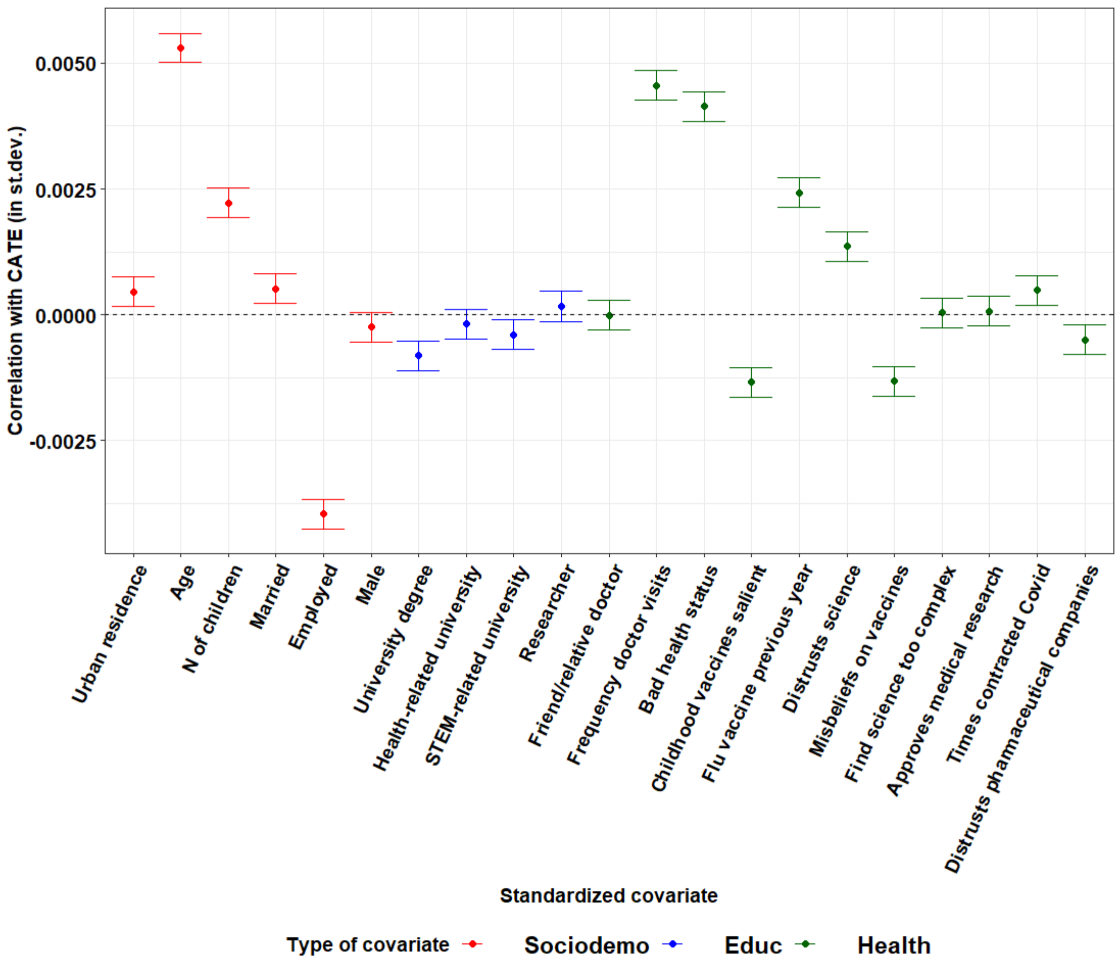
A remaining question is whether causal forests help rationalize the apparent discrepancy between the positive effect of MI on the perception of informants and the null effect on vaccination behavior. CATE estimates on both these outcomes allow us to provide several observations. First, none of the respondents who improved their positive perception score after MI ($N = 1392$) experienced any significant effect on flu vaccination behavior: they belong to separate clusters of study participants. This confirms that effects on thought processes and perceptions do not imply behavioral consequences. Second, as shown in Figure 5, those with a negative behavioral reaction to MI also tend to show a more modest improvement in the positive perception score. This suggests that the average increase in perception scores following MI is not driven by those who had a negative behavioral reaction: the latter is a group of people who experience a separate chain of effects. Third, only 19 respondents have a negative and significant CATE effect on perceptions. One possible hypothesis, which should be addressed more closely by future research, could be a general appreciation of gentle communication techniques following years of direct, more moralizing communication campaigns due to the pandemic. These findings are consistent with our robustness check showing that MI does not lessen distrust of science and vaccines: positive perception increases in people who do not respond in terms of health outcomes, possibly for reasons unrelated to vaccines.

Table 3: Background characteristics across significant and non-significant CATE

	Negative sig. CATE		Non significant CATE		Positive sig. CATE			
Variable	Mean	St.dev	Mean	St.dev	Mean	St.dev	ASD (Positive-non sig.)	ASD (Negative-non sig.)
N of children	0.662	(0.825)	1.254	(0.951)	1.407	(0.852)	0.109*	-0.426
University education (0-1)	0.338	(0.475)	0.26	(0.439)	0.204	(0.404)	-0.087	0.112*
Health-related university studies (0-1)	0.03	(0.171)	0.026	(0.16)	0.009	(0.094)	-0.093	0.017
STEM-related university studies (0-1)	0.098	(0.298)	0.087	(0.281)	0.088	(0.285)	0.004	0.026
Close friend/relative is a doctor (0-1)	0.188	(0.392)	0.188	(0.391)	0.212	(0.411)	0.04	-0.001
Frequency of doctor visits (1-5)	3.075	(0.813)	3.092	(0.892)	3.053	(0.99)	-0.019	-0.009
Bad health status (1-5)	2.18	(0.672)	2.367	(0.758)	2.549	(0.655)	0.109***	-0.111
Saliency of vaccines in childhood (1-3)	2.421	(0.553)	2.442	(0.597)	2.304	(0.641)	-0.082	-0.013
Flu vaccine last year (0-1)	0.353	(0.48)	0.407	(0.491)	0.389	(0.49)	-0.022	-0.067
Distrust of science (1-5)	1.974	(0.772)	2.313	(0.716)	2.657	(0.63)	0.209***	-0.199
Misbeliefs on vaccines (1-5)	2.203	(0.54)	2.419	(0.704)	2.637	(0.63)	0.13***	-0.132
Believes science is too complex (1-5)	2.376	(0.703)	2.782	(1.018)	2.991	(1.039)	0.107**	-0.224
Approves medical research (1-5)	4.212	(0.791)	4.014	(0.856)	3.788	(0.796)	-0.105	0.092***
Times contracted Covid	0.541	(0.657)	0.647	(0.718)	0.743	(0.692)	0.091	-0.102
Distrusts pharmaceutical companies (0-1)	0.211	(0.409)	0.415	(0.493)	0.619	(0.488)	0.253***	-0.268

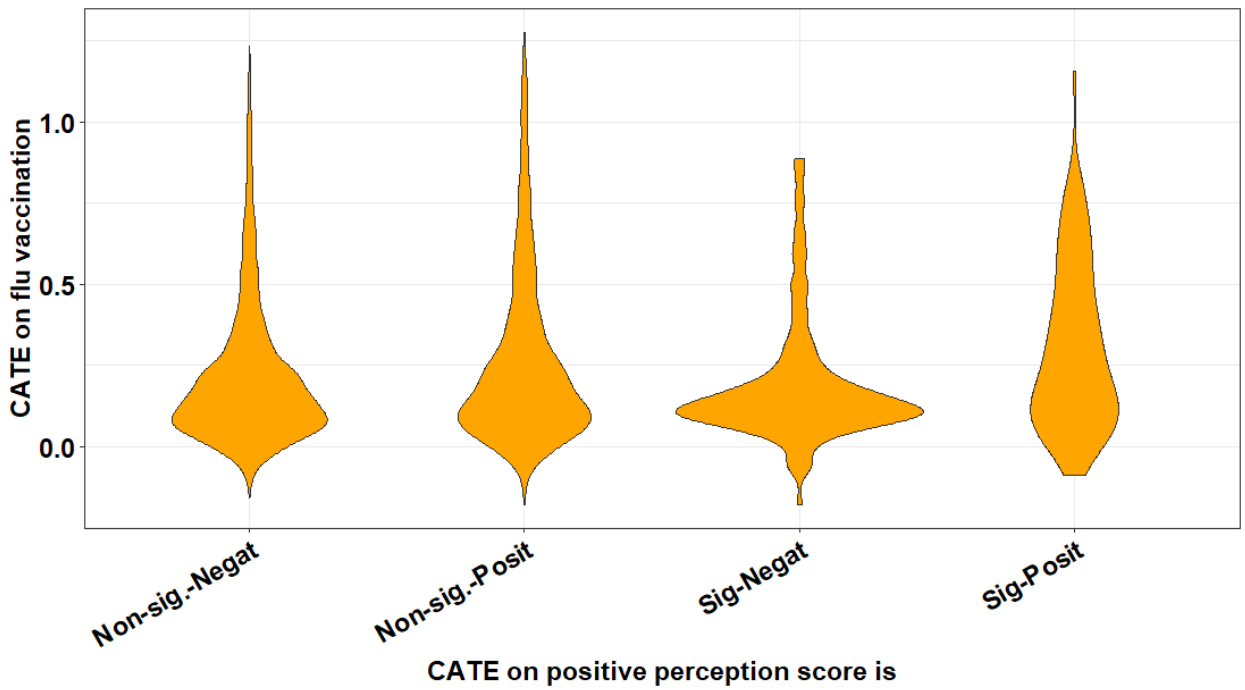
Notes: *p<0.1; **p<0.05; ***p<0.01. P-values refer to two-tailed tests for differences in means with different variances. The table shows the standardized difference in means (ASD) across several baseline characteristics between respondents with a predicted individual treatment effect from MI that is positive-significant, negative-significant, or not statistically significant. The significance of CATE estimates that categorized individuals is assessed by computing Z-scores on individual CATE estimates and comparing them to 5% critical values. For example, the cell in the first row, last column, reports that respondents who reduce their vaccine uptake after exposure to MI have, on average, 0.4 standard deviations fewer children than those who do not respond to MI, but this difference is not statistically significant.

Figure 4: CATE estimates by baseline covariates



Notes: the figure shows the correlation between individual CATE estimates from causal forests and baseline covariates, estimated by linear regression. Bars indicate 95% confidence intervals.

Figure 5: CATE on flu vaccination and CATE on positive perception scores



Notes: the figure illustrates the distribution of CATE on flu vaccination with violin plots, depending on whether the respondent had a significant and positive CATE on the score for the positive perception of the informant.

5 Disccusion and Conclusions

As developed countries face the simultaneous challenges of the risk of new viral pandemics, an aging population, and rising vaccine hesitancy, health authorities seek cost-effective ways to encourage the elderly to vaccinate and adopt preventive health measures against preventable diseases. Since the COVID-19 pandemic, authorities are increasingly using video informational campaigns based on insights from behavioral sciences: image-based communication is more cost-effective, since it is easily derived through traditional and social media, and has higher efficacy relative to written text, a common form of vaccination informational campaigns (e.g., ECDC, 2024b; Cox et al., 2010; Caprini, 2023). Meanwhile, the WHO and several national health authorities recommend relying on gentle communication techniques in doctor-patient interactions that are expensive in terms of both economic resources and the all-too-scarce time of health professionals. At the intersection of these considerations, elements of gentle communication techniques begin to be applied also to large-scale video campaigns.

In this paper, we used a factorial stratified RCT to test the efficacy of gentle communication – in the form of Motivational Interviewing (MI) – in video informational campaigns, relative to more traditional videos based on direct and more paternalistic communication. Despite existing recommendations based on clinical practice, our study finds that MI has limited and even negative consequences in the context of video informational campaigns. On the one hand, respondents appreciate MI, as they rate the informant in the video as consistently more collaborative, considerate, sincere, and trustworthy: in this regard, MI outperforms other more traditional nudges, such as gender concordance or identifying the informant as a medical doctor rather than as a layperson. Nevertheless, this improved perception, which we interpret as a detachment from years of direct communication campaigns following the pandemic, does not translate into a behavioral response, nor into better knowledge of vaccines.

Descriptive comparisons of pre-treatment and post-treatment vaccination choices reveal that this null result is not caused by MI and traditional communication having a positive and comparable effect, but rather by the immobility of vaccination choices despite exposure to treatment. Not only that, respondents exposed to MI have between 2 and 3 percentage points lower likelihood of intending to vaccinate against the flu when asked immediately after being shown the nudged video, compared to unidirectional communication. As surprising and discouraging as it may seem, the finding that nudges can improve perceptions without affecting behavior or knowledge about vaccines is not new in the experimental health literature. Closer to our research question, the same discrepancy has been observed when nudging campaign recipients with correct information on vaccine social norms (Angerer et al., 2024), or when using transparent factual communication rather than persuasion techniques (Kerr et al., 2022). The issue is actually broader than health, pointing to a relevant avenue of future research for economic psychology: similar dynamics have also been observed for fact-checking in the context of political campaigns: while debunking improves factual knowledge, it does not affect voting intentions (Barrera et al., 2020).

We further the understanding of these dynamics using causal forests to estimate individual causal effects of MI. The overall null result is not driven by heterogeneous effects in opposite directions, but rather by a large majority of individuals not changing their intentions and behaviors. Our results also show that while a minority of respondents who are more vaccine-hesitant increase their chance of vaccinating, another minority with a higher baseline propensity to vaccinate at baseline worsens their beliefs about vaccines and decreases the probability of vaccination. Taken together, these minorities account for approximately 3% of the overall sample, which is non-negligible considering that our sample is representative of the Italian over-40 population. Moreover, while numbers are too small to make generalizable conclusions, our result suggests that the individuals experiencing negative effects would be more numerous than those experiencing positive effects. Together with the finding that older respondents in bad health tend to respond more positively to MI, this finding warns against the opportunity to apply MI to large-scale video informational campaigns. Existing studies on MI focused on direct doctor-patient interactions and used smaller samples of patients with a known health-related condition or who display high vaccine hesitancy. Our representative, large sample size of 12004 respondents, allowed us to uncover the potentially detrimental effects of MI in the general population that would go unnoticed in smaller, targeted studies.

Our study faces at least two main limitations. Similar to many contributions in the field, our vaccination measure is not from administrative records but self-reported; reassuringly, previous evidence, which also found unintended negative effects from behavioural nudges in vaccine informational campaigns, has shown that this can lead to attenuation bias, and we are able to show that our results are not driven by a reduced attention (a proxy for effort) or by systematic difference in self-knowledge concerning the vaccination outcome (Dohmen and Jagelka, 2024). We further provide robustness checks that reveal consistency in null effects across a range of different health outcomes referred to both the individual and others. Second, as our main interest lies in assessing the potential of gentle communication techniques in video campaigns relative to other existing nudges and communication strategies, we do not study the effectiveness of gentle communication per se – i.e., relative to no intervention. However, the almost complete immobility of vaccination behaviours before and after our intervention in our data suggests that, in video format, it is also likely to be zero.

Conversely, our results highlight the limits and perils of gentle communication techniques such as MI relative to direct communication, in a moment when they are recommended across various communication media. We conclude that gentle communication should not be employed in large-scale video interventions, as these might exacerbate distrust in health authorities if applied outside of specifically selected targets. Overall, the decreased cost from implementing a video informational campaign could be offset by a greater cost from increased vaccine hesitancy and possibly a higher incidence of preventable diseases.

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APPENDIX

A Video scripts

A.1 Script 1: Unidirectional communication. Duration: 1.45 minutes

Off-screen voice: Influenza vaccine: why get it?

Informant: The influenza vaccine is the most effective tool for preventing the flu and its most serious manifestations. It is recommended for everyone over the age of 50.

Off-screen voice: Is the influenza vaccine really necessary?

Informant: The flu should not be underestimated; every year in Italy it affects hundreds of thousands of people and can have very serious complications that require hospitalization. According to recent studies, these complications occur in patients who are 50 years and older.

Off-screen voice: Is the influenza vaccine also useful for those who have never been sick?

Informant: Even if you have had no complications from the flu so far, you are not safe from this year's virus. If you want to protect yourself, get vaccinated.

Off-screen voice: Does the influenza vaccine have side effects?

Informant: The influenza vaccine cannot cause the flu, not even in a mild form. Anyone who says otherwise is lying. The only side effects the vaccine can cause are swelling or mild soreness at the injection site, and they are short-lived. On the other hand, getting the flu can have harmful consequences for your health. Make the right choice, get vaccinated.

Off-screen voice: How do you get vaccinated?

Informant: If you still have doubts or if you want to book the flu vaccine, you can contact your family doctor. Don't let the flu stop you.

Off-screen voice: Don't let the flu stop you, get vaccinated!

A.2 Script 2: Motivational Interviewing, Informant is a medical doctor. Duration: 1.42 minutes

Patient: So, thank you doctor, have a good day!

Informant (doctor): Mr. Rossi, wait! I noticed that you haven't gotten the flu vaccine this year. The vaccine is recommended for all people over 50. Have you thought about getting it?

Patient: I don't think I need it.

Informant (doctor): May I ask why you think so?

Patient: It's been ten years since I've had the flu, and I don't want to risk the vaccine making me sick.

Informant (doctor): I understand your concerns. However, the flu vaccine does not cause the flu, not even in a mild form. It can, at most, cause temporary swelling or soreness at the injection site. The flu, on the other hand, can have harmful health consequences.

Patient: I understand, doctor, but I still don't think the vaccine is right for me.

Informant (doctor): It's important that you've considered whether to vaccinate or not, Mr. Rossi. You are the only one who can decide for yourself. I understand that you think it's not easy to catch the flu, but maybe you're not ruling it out entirely. Am I right?

Patient: Well sure, you can't be 100% sure, some people I know have had a bad flu this year.

Informant (doctor): You're right. Unfortunately, in a season like this, the flu affects hundreds of thousands of people, and some complications may require hospitalization. The most severe cases are indeed among those aged 50 and over.

Patient: I thought it was much further along.

Informant (doctor): Listen, I have here a couple of pamphlets that explain how the vaccine is the most effective tool for preventing flu and serious symptoms. Maybe you're not completely convinced, but what would you say if we read them together?

Patient: Okay, thank you, at least I'll get an idea.

A.3 Motivational Interviewing, Informant is not a medical doctor. Duration: 1.45 minutes

Receiver: Hi Paolo, you here too?

Informant: Hi Claudio, I have an appointment to get the flu vaccine; my doctor recommends it for those over 50. Have you thought about getting it too?

Receiver: I don't think I need it.

Informant: Why do you think that?

Receiver: It's been ten years since I've had the flu, and I don't want to risk the vaccine making me sick.

Informant: I understand. However, the doctor told me that the vaccine cannot cause the flu, not even in a mild form. At most, there can be some swelling or temporary soreness at the injection site. The flu, on the other hand, can cause health damage.

Receiver: I understand Paolo, but I don't think the vaccine is right for me.

Informant: In the meantime, you've considered whether to get vaccinated or not, I think it's very important. In the end, you are the only one who can decide what works for you, and I understand that you think it's not so easy to get the flu. But maybe you're not ruling it out entirely, am I right?
Receiver: Well certainly, you can't be 100% sure, some people I know have had a bad flu this year.
Informant: You're absolutely right. My doctor also told me that unfortunately, in a season like this, the flu affects many people, and some complications can even send people to the hospital. And think that the most severe cases occur in people over 50.
Receiver: I thought it was much later!
Informant: Look, the doctor gave me a couple of pamphlets that explain how the vaccine is the most effective method to prevent flu and serious symptoms. Maybe you're not entirely convinced, but if you want, we can look at them together, there's a wait here anyway.
Receiver: Sure, thank you, at least I'll get an idea.

B Surveys

These surveys have been used to collect data for a number of projects in different disciplines, meaning that not all questions were envisaged for being used in the present study. Both surveys were administered in Italian, and we now present them translated into English. Moreover, for some respondents (especially those above age 75), the survey was administered face-to-face, showing the video on a tablet. These surveys were deposited as part of the trial pre-registration.

B.1 First wave

The following questions concern your relationship with medicine and science. Please indicate the option that best describes you.

- **A.1 The doctor you consult most often:**
  - My general practitioner
  - A specialist
  - An acquaintance, relative, or friend who is also a doctor
  - No doctor

- **A.2 How often do you consult doctors?** These may be your general practitioner, a specialist, or other doctors you know.
  - I do not remember the last time I consulted a doctor
  - About once a year
  - 2-3 times a year
  - About once a month
  - About once a week or more often
  - I do not have a trusted doctor
- **A.3 Last year (Autumn 2022), did you get the flu vaccine?**
  - Yes
  - Not sure, probably yes
  - Not sure, probably no
  - No
- **A.3B Thinking about the vaccines you received as a child, which statement do you agree with most?**
  - I received all the vaccines that were possible
  - I received only the mandatory vaccines
  - I received few or no vaccines
  - I do not remember
- **A.4a How many times have you contracted Covid?**
  - None
  - 1
  - 2
  - 3 or more
- **A.4b How many doses of the COVID vaccine have you received?**
  - None
  - 1

- 2
- 3
- 4

- **A.5 How much do you agree with the following statements?**
  - Science is so complicated that I do not understand much of it
  - Medical research makes our lives healthier, simpler, and more comfortable

- **A.6 You will be presented with some statements. Could you tell us how much you agree with each of these?**

  a) Scientists ignore results that contradict their work

  b) Scientists do not take into account the ideas of others

  c) The work of scientists contributes to improving people's lives

  d) Most scientists perform their work honestly

  e) Science cannot be relied upon because it proceeds too slowly

  1. Not at all in agreement
  2. Slightly agree
  3. Neither agree nor disagree
  4. Quite agree
  5. Completely agree

- **A.7 How many children do you have?**
  - None
  - 1
  - 2
  - 3 or more

- **A.7.A (If A.7 != "None")** What is the birth year of your youngest child?
  - Open field with constraints

- **A.7.A (If A.7 != "None")** How many vaccines has your young child received?

- None
- Only the mandatory ones
- All or almost all
- I do not know

- **A.7.B (If A.7 == "None")** If you had children, how many vaccines would they receive?
  - None
  - Only the mandatory ones
  - All or almost all
  - I do not know

- **A.8 We list some common concerns about vaccines. For each, indicate how much you agree:**
  - Vaccines act on the immune system
  - Vaccines often cause severe and irreversible side effects
  - Vaccines do not protect against diseases but cause them in severe forms
  - The pharmaceutical industry administers harmful treatments (e.g., vaccines) without people's consent to make them sick and increase drug sales (produced by them)

2. We now ask you to watch this short video lasting 2 minutes. The following questions will relate to the video. Please note that your attention to the video may be monitored. *[Video]* ____________________

3. The following questions relate to the video you just watched.

- **C.1 How many of the information contained in the video were already known to you?**
  - 1-4 (I knew nothing - I knew everything)
- **C.2 How attentively did you watch the video?**
  - 1-4 (Little - Much)
- **C.3 Below we list characteristics that may describe the presenter in the video. For each, indicate whether you think it describes the presenter.**
  - Reliable/Unreliable/Collaborative/Arrogant/Caring/Indifferent/Reassuring/Disturbing/Good-looking/Ugly/Sincere/Deceptive/Intelligent/Unprepared

D1: Below we list some statements about the flu vaccine. Some relate to information mentioned in the video, others do not. Indicate those which you believe were mentioned in the video.

- **Values: 0-1**
  - 0 Unchecked
  - 1 Checked
- **[D1r1]** The flu vaccine can cause flu-like symptoms. *False (answer not shown in the survey)*
- **[D1r2]** This year's flu virus is particularly aggressive. *False (answer not shown in the survey)*
- **[D1r3]** The flu vaccine can cause swelling and soreness at the injection site (on the arm). *True (answer not shown in the survey)*
- **[D1r4]** People over 50 years can experience the flu more severely. *True (answer not shown in the survey)*

---

5. We now have two questions regarding your intentions for the coming year

- **E.1 Do you expect to follow pharmacological treatments this year?**
  - No/Probably not/Probably yes/Yes
- **E.2 Do you plan to get the flu vaccine this year?**
  - No/Probably not/Probably yes/Yes

---

6. CRT_6 TEST (Section name not shown in the survey) *Read the following questions carefully and enter your answer in the column on the right.*

1. A chocolate and a candy cost €1.10 in total. The chocolate costs €1 more than the candy. How much does the candy cost? ___ cents
2. If 5 machines in 5 minutes produce 5 keychains, how long does it take 100 machines to produce 100 keychains? ___ minutes
3. In a lake, there is a patch of water lilies. Each day the patch doubles in size. If in 48 days the patch covers the entire lake, how many days does it take to cover half the lake? ___ days
4. If 3 clerks can wrap 3 toys in 1 hour, how many clerks are needed to wrap 6 toys in 2 hours? ___ clerks

5. Marco's grade is both the 15th highest and the 15th lowest in his class. How many students are there in his class? ___ students
6. In a track team, tall athletes tend to win 3 times more than short ones. This year the team won 60 medals. How many medals were won by short athletes? ___ medals

---

7. The last 9 questions gather some additional information about you.

* **G.1 What is your year of birth?**
  · Open field with constraints/Dropdown menu
* **G.2 You identify as:**
  · Male/Female/Other
* **G.3 What is the highest educational title you have achieved?**
  · Up to elementary school certificate
  · Middle school diploma
  · High school diploma or vocational qualification
  · University degree or three-year degree
  · Master's degree, specialized or single-cycle degree
  · Doctorate or postgraduate specialization
* **G.3A [If F.3¿=Degree]** What is the specialization of your studies? You may select up to two choices
  · Medicine and surgery
  · Another health faculty (e.g., nursing, dentistry, pharmacy, veterinary)
  · Natural sciences (e.g., physics, chemistry, biology, geology)
  · Mathematical sciences (e.g., mathematics, statistics, computer science)
  · Engineering
  · Humanities (e.g., letters, philosophy, art history)
  · Social sciences (e.g., psychology, economics, history, political sciences, law)
  · Other: specify _____
* **G.4 You are currently:**
  · Employed (or temporarily on leave)
  · Student (not paid by an employer)
  · Unemployed

- Unable to work
- Retired
- Dedicated to family care
- Other

* **G.5 Do you have or have had any of the following professions?** (filter for employed and retired)
  - Doctor
  - Nurse or dentist
  - Veterinary doctor
  - Pharmacist
  - Phytotherapist/naturopath
  - Psychologist or psychotherapist
  - Researcher
  - None of the above

* **G.6 Do you have relatives or close friends who perform or have performed any of the following professions?**
  - Doctor
  - Nurse or dentist
  - Veterinary doctor
  - Pharmacist
  - Phytotherapist/naturopath
  - Researcher
  - No, none of the above

* **G.7 You are currently:**
  - Single
  - Married cohabiting and not cohabiting with spouse
  - Factually separated/Legally separated/Divorced
  - Widowed

* **G.7.1 [If G.7. is Single, Separated-Divorced, Widowed]** You are currently:
  - Single
  - In a romantic relationship and cohabiting with your partner
  - In a romantic relationship but not cohabiting with your partner

* **G.7.2 [If G.7. is Single, Married cohabiting and not cohabiting with the spouse, Widowed]** Have you ever lived with a partner (spouse or cohabitant) with whom the relationship has ended?
    - Yes
    - No
* **G.7.2.A [If G.7.2==yes or if G7==Factually separated/Legally separated/Divorced]** If yes, can you indicate the year of the de facto separation? (if you had more than one past ended relationship, refer to the most recent relationship)
    - ____
* **G.8 With whom do you live?** (multiselect)
    - Parents
    - Own children
    - Partner's children
    - Siblings
    - Grandchildren
    - In-laws (e.g., brother-in-law, son-in-law, daughter-in-law)
    - Other roommates: friends/colleagues/students/workers
    - I live alone [deselect previous]
* **G.9 Which definition best describes the area where you currently live?**
    - Municipality with less than 5,000 residents
    - Municipality of 5,000-49,999 residents
    - Municipality of 50,000-99,999 residents
    - Municipality of 100,000 or more residents
* **G.10 How is your general health?**
    - Very good/Good/Neither good nor bad/Bad/Very bad
* **G.11 Do you suffer from chronic diseases or long-term health problems?**
    - Yes/No

---

8. Survey appreciation

* **H.1 How did you find this questionnaire?**
    - Less respectful than others you have answered/ Same as others you have answered/ More respectful than others you have answered

* **H.2 Is there anything else you would like to tell us about this questionnaire?** (open field)

B.2 Second survey

1. How much do you agree with the following statements?

* Science is so complicated that I do not understand much of it / Medical research makes our lives healthier, simpler, and more comfortable
  · Not at all in agreement
  · Disagree
  · Neither agree nor disagree
  · Agree
  · Totally agree

---

2. You will be presented with some statements. Could you tell us how much you agree with each of these?

a) Scientists ignore results that contradict their work
b) Scientists do not take into account the ideas of others
c) The work of scientists contributes to improving the lives of people
d) Most scientists perform their work honestly
e) You cannot rely on science because it proceeds too slowly

* 1. Not at all in agreement
* 2. Slightly agree
* 3. Neither agree nor disagree
* 4. Quite agree
* 5. Completely agree
* 6. Don't know

3.

– **A.8 We list some common concerns about vaccines. For each, indicate how much you agree:**

1. Vaccines act on the immune system
2. Vaccines often cause severe and irreversible side effects

3. Vaccines do not protect against diseases but cause them in severe forms
4. The pharmaceutical industry administers harmful treatments (e.g., vaccines) without people's consent to make them sick and increase drug sales (produced by them)

* 1. Not at all in agreement
* 2. Slightly agree
* 3. Neither agree nor disagree
* 4. Quite agree
* 5. Completely agree
* 6. Don't know

---

4. From September to today, have you been sicker compared to the same period last year?

* Yes/No/Not sure

---

5. In the last few months, how often have you consulted doctors, excluding any emergency room visits?

* Never/Once/2-3 times/About once a month/About once a week or more often

---

6. From September to today, what vaccines have you received?

* None/Flu vaccine/Covid vaccine dose/Other vaccines: ____

---

7. From September to today, have you undergone any medical tests?

* Blood tests/Urine and feces analysis/Screening for specific diseases (e.g., colonoscopy, mammography)/Other: ____

---

8. Consider the situation of Mario. Mario is 60 years old, lives in a big city, and in March of this year, he had surgery for a cyst on his right lung. As a result, he now suffers from respiratory failure. What would you recommend to Mario regarding the flu vaccine?

* Nothing/To get the flu vaccine/Not to get the flu vaccine/Other: ____

---

9. Is there anything else you would like to tell us about this questionnaire?
(open) ________________ ____

C Summary statistics, covariates and balance

C.1 Summary statistics and covariates

In all our analyses we include the following covariates:

- **Socioeconomic background:** urban residence (0-1),; age (continuous, 40-90); number of children; married (0-1); still employed (0-1); university education (0-1); medical-oriented university studies (0-1: 1 if they studied medicine, odontoiatry, nursing, veterinary medicine, pharmacy); STEM-oriented university studies (0-1: 1 if they studied mathematics, natural sciences, engineering, architecture); a close friend or relative is a doctor (0-1).
- **Self-assessed health status:** Answer to the question "How would you rate your general health condition?" (Likert scale 1-5);
- **Baseline attitudes toward vaccines and science:** vaccinated against the flu last year (0-1); wrong beliefs on vaccine (average agreement with the following statements on a Likert scale 1-5, reverting scales so that 5 corresponds to a wrong belief: (i) Vaccines act on the immune system; (ii) Vaccines often cause serious and irreversible adverse effects; (iii) Vaccines do not protect against diseases but actually cause them in serious form); vaccine salience when children (1-3: 1 if they received few or no vaccines, or they don't remember, 2 if they received only compulsory vaccines, 3 if they received all vaccines); distrust of science (average agreement with the following statements on a Likert scale 1-5, reverting scales so that 5 corresponds to highest levels of distrust: (i) Scientist ignore results that contradict their work; (ii) Scientist do not consider other people's ideas; (iii) Scientists' work contributes to improve people's lives; (iv) Most scientists perform their work honestly; (v) One cannot rely on science because it proceeds too slowly).
- **Health habits:** frequency of doctor visits (Likert scale 1-5).

Summary statistics for baseline covariates are presented in Table C.1.

Table C.1: Covariates: summary statistics

	Mean	sd	min	p25	p75	max
Urban	0.468	0.499	0	0	1	1
Age	58.164	11.479	40	49	67	90
N. of children	1.288	0.959	0	0	2	3
Married	0.733	0.442	0	0	1	1
Employed	0.511	0.5	0	0	1	1
University degree	0.233	0.423	0	0	0	1
Doctor as relative or friend	0.201	0.4	0	0	0	1
Medicine-related degree	0.024	0.155	0	0	0	1
STEM-related degree	0.079	0.269	0	0	0	1
Frequency of doctor visits	3.12	0.905	1	3	4	5
Bad self-assessed health	2.377	0.77	1	2	3	5
Saliency vaccines in childhood	2.415	0.61	1	2	3	3
Vaccinated against flu last year	0.433	0.496	0	0	1	1
Distrust of science	2.31	0.724	1	1.8	2.8	5
Wrong beliefs on vaccines	2.429	0.701	1	2	3	5

Table C.2 reports the distribution of observations across age classes, and Table C.3 shows the distribution of educational attainment by age class. Figure C.1-Figure C.3 describe pre-treatment flu vaccine uptake and skepticism by age class. Despite large differences in educational attainments and an increasing pattern of uptake with age (all below recommended coverage), different age classes at baseline are not significantly different in terms of vaccine skepticism and distrust of science.

Table C.2: Observations by age class

Age class	N	% of obs
40-44	1531	12.76
45-49	1786	14.89
50-54	1824	15.21
55-59	1747	14.56
60-64	1471	12.26
65-69	1231	10.26
70-74	1092	9.1
75+	1314	10.95

Table C.3: Educational attainment by age class

Age class	**Middle School or Lower (%)**	**High School (%)**	**Bachelor or Higher (%)**
40–44	14.0	51.3	34.7
45–49	19.0	51.2	29.8
50–54	21.6	53.7	24.8
55–59	23.8	53.3	22.9
60–64	24.8	57.6	17.6
65–69	20.1	60.1	19.8
70–74	22.0	58.6	19.4
75+	54.0	33.2	12.9

Figure C.1: Pre-treatment flu vaccine uptake by age class

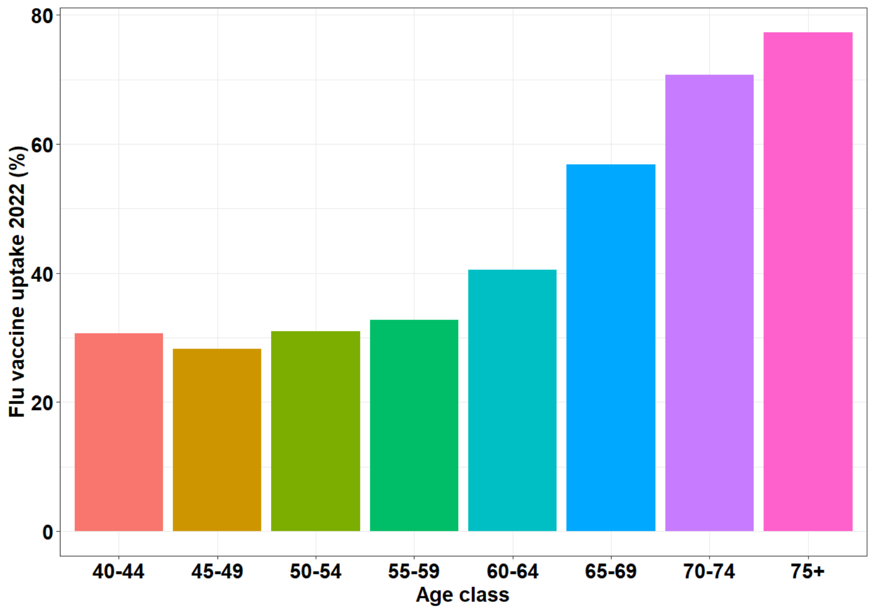
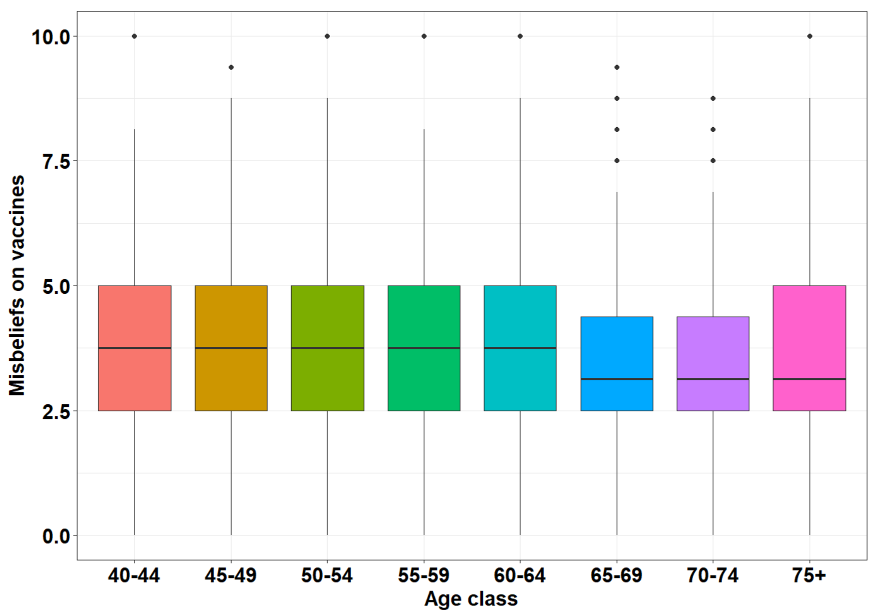
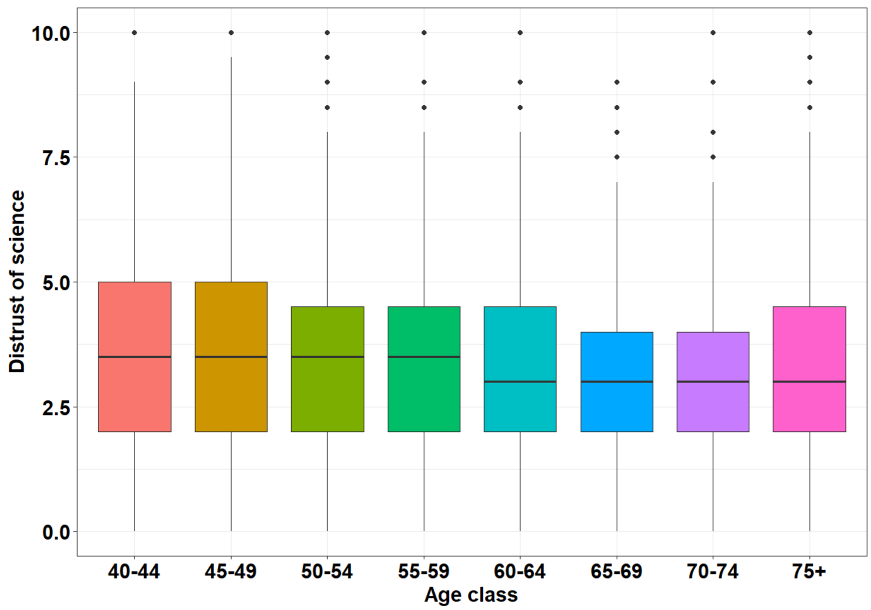


Figure C.2: Vaccine misbelief score by age class



Notes: The figure shows the distribution of the "wrong beliefs on vaccines" score (average agreement with wrong statements on vaccines detailed in covariates' description) by age class.

Figure C.3: Distrust of science score by age class



Notes: The figure shows the distribution of "distrust of science" score (detailed in covariates' description) by age class.

We also collected more variables related to respondents' experience with COVID-19 and more specific indicators of educational background. As expected in a randomized controlled trial, their inclusion does not alter results. Moreover, since these indicators are highly correlated with the included covariates mentioned above, they do not reduce estimates' variance further. Therefore, we omit them from our results for the sake of clarity: we can, however, provide those results upon request.

C.2 Balance tests

In the figures below, we show balance of both included and some of these additional covariates relative to each individual treatment. For each baseline covariate X, we assess balance by computing the Average Standardized Difference (ASD) between treatment and control groups, considering each treatment separately. It is computed as:

$$ASD(X) \equiv \frac{|\bar{X}_T - \bar{X}_C|}{\sqrt{Var_T(X) + Var_C(X)}}$$

so that it expresses difference between the two groups in terms of standard deviations. A commonly accepted rule of thumb for balance is a value of ASD below 0.1. Results are reported in Table C.4-Table C.6.

Table C.4: Balance (ASD) relative to T_{MI}

	Absolute standardized distance	Mean, control	Mean, treated
Urban	0.0179	0.4613	0.4739
Age	0.0028	58.1871	58.1408
N. of children	0.0142	1.2793	1.2969
Married	0.0116	0.7368	0.7295
Employed	0.0012	0.5114	0.5106
University degree	0.0021	0.2326	0.2338
Doctor as relative or friend	0.0099	0.2034	0.1978
Medicine-related degree	0.0061	0.0252	0.0238
STEM-related degree	0.018	0.0753	0.0822
Frequency of doctor visits	0.0145	3.11	3.1296
Bad self-assessed health	0.0108	2.3711	2.3829
Saliency vaccines in childhood	0.0105	2.4187	2.412
Vaccinated against flu last year	0.0031	0.4341	0.4319
Distrust of science	1e-04	2.3095	2.3108
Wrong beliefs on vaccines	0.0112	2.4239	2.4339

Table C.5: Balance (ASD) relative to T_G

	Absolute standardized distance	Mean, control	Mean, treated
Urban	0.0047	0.4659	0.4693
Age	0.006	58.1155	58.2124
N. of children	0.0068	1.2932	1.2831
Married	0.0039	0.7344	0.732
Employed	0.0021	0.5102	0.5117
University degree	0.0015	0.2336	0.2327
Doctor as relative or friend	0.0058	0.199	0.2022
Medicine-related degree	0.0015	0.0243	0.0247
STEM-related degree	0.0031	0.0793	0.0781
Frequency of doctor visits	0.0149	3.1112	3.1283
Bad self-assessed health	0.0151	2.3853	2.3688
Saliency vaccines in childhood	0.0054	2.4173	2.4134
Vaccinated against flu last year	0.0122	0.4288	0.4373
Distrust of science	0.0212	2.3017	2.3186
Wrong beliefs on vaccines	0.011	2.4232	2.4346

Table C.6: Balance (ASD) relative to T_{MED}

	Absolute standardized distance	Mean, control	Mean, treated
Urban	0.0064	0.4698	0.4653
Age	0.0022	58.1821	58.1458
N. of children	0.0070	1.294	1.2823
Married	0.0093	0.7303	0.7361
Employed	0.0000	0.511	0.511
University degree	0.0008	0.2329	0.2334
Doctor as relative or friend	0.0082	0.1983	0.2029
Medicine-related degree	0.0046	0.024	0.025
STEM-related degree	0.0127	0.0811	0.0763
Frequency of doctor visits	0.0116	3.1155	3.1241
Bad self-assessed health	0.0073	2.381	2.373
Saliency vaccines in childhood	0.0284	2.4285	2.4023
Vaccinated against flu last year	0.0176	0.4269	0.4392
Distrust of science	0.0147	2.3156	2.3047
Wrong beliefs on vaccines	0.0015	2.4308	2.427

D Deviations from the Pre-Analysis Plan

This trial is part of a larger research consortium and was pre-registered in the AEA-RCT Registry with title *"Listen to me, I will respond": a randomized communication trial on vaccination decisions* and RCT ID number AEARCTR-0011862. This section will summarize the main deviations from the Pre-Analysis Plan (PAP), which is publicly available.

The secondary outcomes reported in the PAP, namely (i) agreement with common misconceptions around vaccines, (ii) trust in science and scientists, and (iii) spillovers on other forms of preventative medicine, are not reported in the main text of this paper, but rather in the Appendix (in Section F and Section G).

On the other hand, the secondary outcomes used to assess mechanisms in this paper include attention scores (pre-registered in the mechanisms section) alongside perception scores, which were not mentioned in the PAP. Nevertheless, perception questions were reported in the survey document uploaded as part of the pre-registration. Attention checks based on eye-tracking were not performed due to technical issues at the time of implementation.

Finally, the analysis of interactive effects between different nudges were also reported in the Appendix (Section F), as it did not highlight results of primary interest.

E Attrition

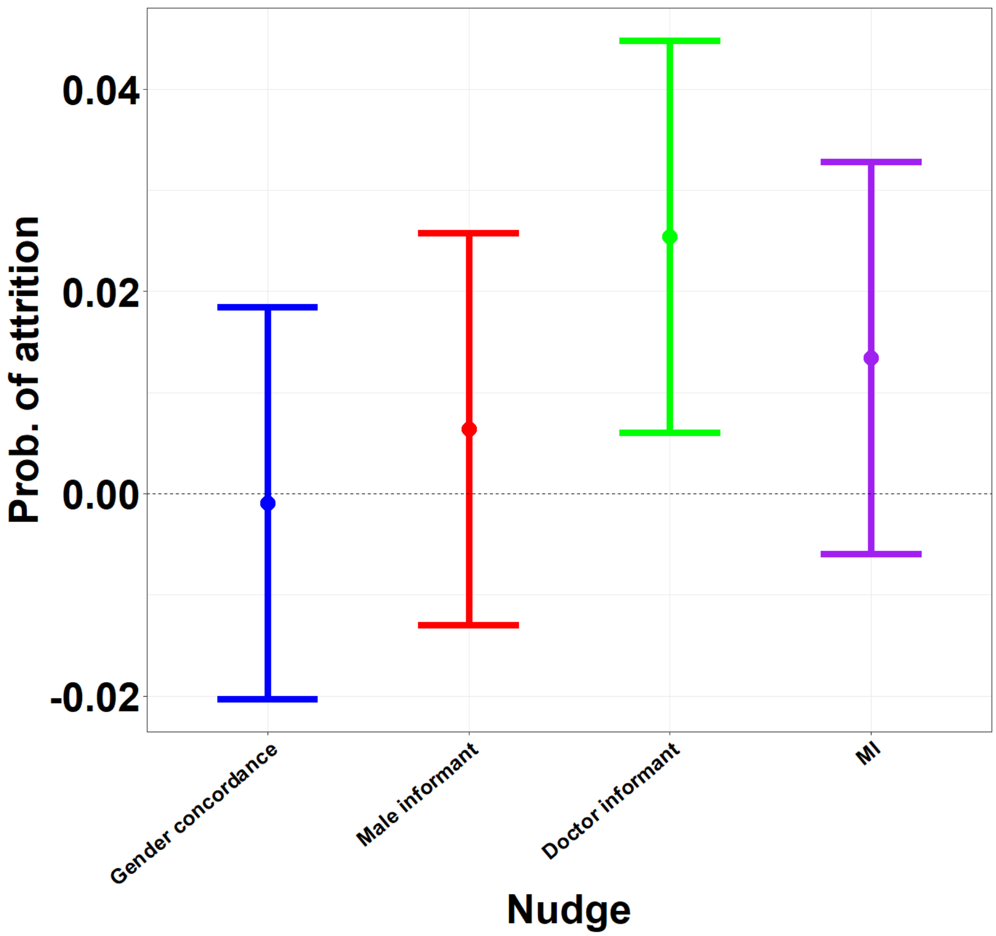
To determine whether treatment nudges determine attrition from the first to the second wave, we regress a binary indicator of attrition on each binary treatment separately.

The results are reported graphically in Figure E.4. We find that being exposed to an informant who is a medical doctor increases the probability of attrition (i.e., not answering the second survey) by 4 percentage points. No other binary treatment causes attrition. Importantly, this implies that the effects of MI within cells defined by fixed values of T_{MED} are point identified: this applies to both our main analysis that controls for T_{MED}, and the extra results in Section F that assess the effects of MI under different values of all other treatment nudges. Indeed, as an extra check, in Table E.7 we show that our main treatment of interest, MI, results in very similar levels of selection (i.e., observability in the second wave) conditional on other treatments T_{MED}, T_G, and the gender of the informant in the video.

On the other hand, (i) assessing the direct effects of T_{MED} on second wave outcomes and (ii) comparing the effects of MI (or gender concordance) across cells defined by different values of T_{MED} could be impacted by differential attrition. To this end, we provide two pieces of evidence that indicate the absence of attrition-induced bias in our point estimates.

First, in Table E.8, we present Lee bounds for the direct effect of T_{MED} for each outcome measured in the second wave, both primary and secondary. With the exception of the COVID-19 self-reported vaccination, which still exhibits small magnitudes, all the intervals defined by Lee bounds cross zero. Given that point estimates from the main analysis are close to zero in magnitude and statistically insignificant, these intervals confirm that even under the most extreme selection scenarios, the direct effects of T_{MED} are irrelevant. Then, turning to interactions, Table E.9-Table E.10 below display the Lee bounds for the interaction terms in two linear models where we individually interact T_{MI} and T_G with T_{MED}. The rationale is showing that differences in selection caused by T_{MED} do not fundamentally change how we interpret differences in the effects of T_{MI} and T_G across cells – e.g., in the tables from Section F of the Appendix.

Figure E.4: Attrition by treatment nudge



Notes: The figure shows coefficients and 95% confidence intervals from linear probability models that regress a binary indicator of attrition on binary treatment indicators (individually).

Table E.7: Selection rates for MI effect estimation by treatment combinations

T_{MED}	T_G	Male informant	Selection rate ($T_{MI}=0$)	Selection rate ($T_{MI}=1$)
0	0	0	0.720	0.693
0	0	1	0.695	0.689
0	1	0	0.721	0.687
0	1	1	0.716	0.704
1	0	0	0.677	0.697
1	0	1	0.689	0.674
1	1	0	0.686	0.679
1	1	1	0.680	0.669

Note: The table reports selection rates (i.e., observability in the second wave) for MI by treatment arm combinations.

Table E.8: Lee bounds for the effect of doctor informant nudge (T_{MED}) on second-wave outcomes

Outcome	Lower bound	Upper bound
Flu vaccination [0/1]	-0.0114	0.0201
COVID-19 vaccination [0/1]	0.0051	0.0367
Flu third person [0/1]	-0.0221	0.0095
Any medical tests [0/1]	-0.0106	0.0877
Frequency medical tests [1-5]	-0.0207	0.0109
Distrust of science [1-5]	-0.0443	0.0491
Wrong vaccine beliefs [1-5]	-0.0402	0.0543

Notes: Lee bounds computed within cells defined by $T_{MI} \times T_G$. The attrition-driving treatment is T_{MED}. Bounds are aggregated across blocks, weighted by baseline block shares.

Table E.9: Linear model with interaction $T_{MI} \times T_{MED}$ and Lee bounds on the interaction

	Estimate
Constant	0.349***
	(0.010)
T_{MED}	0.008
	(0.015)
T_{MI}	0.011
	(0.015)
$T_{\text{MED}} \times T_{\text{MI}}$	-0.017
	(0.021)
Lee bounds (interaction)	[-0.054, 0.013]

Notes: Standard errors in parentheses. Lee bounds computed within cells defined by `Informant gender` $\times$ T_G. The attrition-driving treatment is T_{MED}. Bounds are aggregated across blocks, weighted by baseline block shares. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

Table E.10: Linear model with interaction $T_G \times T_{MED}$ and Lee bounds on the interaction

	Estimate
Constant	0.352***
	(0.010)
T_{MED}	-0.005
	(0.015)
T_{G}	0.004
	(0.015)
$T_{\text{MED}} \times T_{\text{G}}$	0.009
	(0.021)
Lee bounds (interaction)	[-0.022, 0.045]

Notes: Standard errors in parentheses. Lee bounds computed within cells defined by `Informant gender` $\times$ T_{MI}. The attrition-driving treatment is T_{MED}. Bounds are aggregated across blocks, weighted by baseline block shares. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.10$.

F Extra results

Table F.11: Effect of MI on intention to vaccinate against the flu across treatment cells

All respondents		2nd wave respondents				
MI effect	**s.e.**	**MI effect**	**s.e.**	**Informant is a**	**Informant is a**	**Respondent is a**
-0.0402**	(0.0183)	-0.0518**	(0.0224)	Doctor	Man	Man
-0.0169	(0.0183)	-0.0251	(0.0222)	Doctor	Woman	Man
-0.0129	(0.0184)	-0.0339	(0.0225)	Doctor	Man	Woman
-0.0117	(0.0184)	-0.0293	(0.0224)	Doctor	Woman	Woman
-0.0318*	(0.0184)	-0.0128	(0.0219)	Layperson	Man	Man
-0.0265	(0.0184)	-0.0184	(0.0220)	Layperson	Woman	Man
-0.0127	(0.0184)	-0.0133	(0.0222)	Layperson	Man	Woman
-0.0422**	(0.0183)	-0.0448**	(0.0219)	Layperson	Woman	Woman

Notes: *p<0.1; **p<0.05; ***p<0.01. The table shows the marginal effects of MI-style communication on willingness to vaccinate against the flu across all combinations of other nudges. The effects are obtained by estimating margins on a fully saturated OLS model that includes all nudges and all their possible interactions, plus baseline covariates.

Table F.12: Effect of MI on self-reported flu vaccinations across treatment cells

MI effect	s.e.	Informant is a	Informant is a	Respondent is a
-0.0414*	(0.0217)	Doctor	Man	Man
-0.0336	(0.0215)	Doctor	Woman	Man
0.0047	(0.0218)	Doctor	Man	Woman
0.0023	(0.0217)	Doctor	Woman	Woman
0.0114	(0.0213)	Layperson	Man	Man
-0.0009	(0.0213)	Layperson	Woman	Man
-0.0003	(0.0216)	Layperson	Man	Woman
-0.0014	(0.0212)	Layperson	Woman	Woman

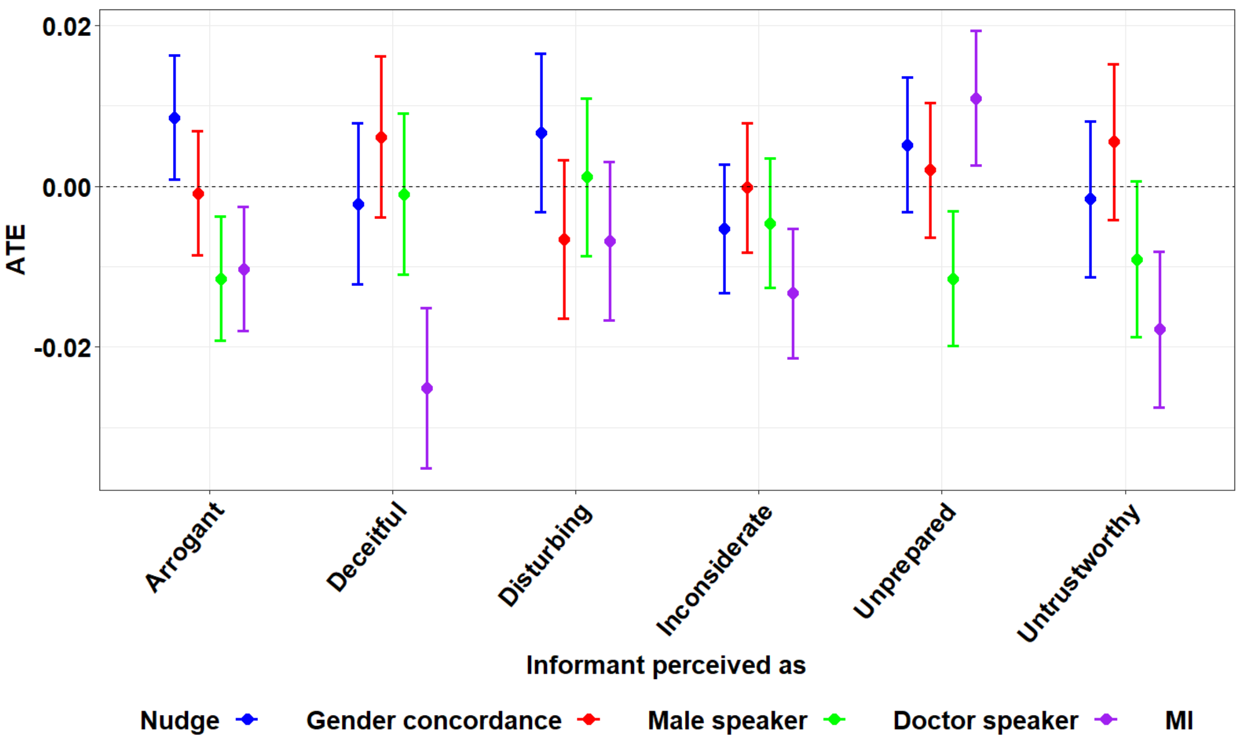
Notes: *p<0.1; **p<0.05; ***p<0.01. The table shows the marginal effects of MI-style communication on self-reported flu vaccination across all combinations of other nudges. The effects are obtained by estimating margins on a fully saturated OLS model that includes all nudges and all their possible interactions, plus baseline covariates.

Table F.13: Effect of MI on self-reported COVID-19 vaccinations across treatment cells

MI effect	s.e.	Informant is a	Informant is a	Respondent is a
-0.0466**	(0.0216)	Doctor	Man	Man
0.0216	(0.0214)	Doctor	Woman	Man
0.0101	(0.0217)	Doctor	Man	Woman
0.0160	(0.0216)	Doctor	Woman	Woman
0.0306	(0.0212)	Layperson	Man	Man
-0.0378*	(0.0212)	Layperson	Woman	Man
-0.0055	(0.0214)	Layperson	Man	Woman
0.0120	(0.0211)	Layperson	Woman	Woman

Notes: *p<0.1; **p<0.05; ***p<0.01. The table shows the marginal effects of MI-style communication on self-reported COVID-19 vaccination across all combinations of other nudges. The effects are obtained by estimating margins on a fully saturated OLS model that includes all nudges and all their possible interactions, plus baseline covariates.

Figure F.5: Negative perception score: nudges effect on individual items



Notes: the figure shows the ATE estimates and 95% confidence intervals for all nudges on the individual items used to compute the negative perception score. Respondents are asked to indicate with binary answers how they would describe the informant in the video.

Table F.14: Descriptives: 2022 and 2023 vaccination behavior by T_{MI}

2022 flu vaccine	2023 flu vaccine	N. respondents
Unidirectional ($T_{MI=0}$)		
No	No	2309
No	Yes	212
Yes	No	404
Yes	Yes	1265
MI ($T_{MI=1}$)		
No	No	2214
No	Yes	202
Yes	No	440
Yes	Yes	1264

Notes: The table shows the number of second-time respondents by their 2022 and 2023 self-reported flu vaccination, and their exposure to MI communication.

Table F.15: Background characteristics across significant and non-significant CATE

Variable	Mean	St.dev	Mean	St.dev	Mean	St.dev	ASD (Positive-non sig.)	ASD (Negative-non sig.)
N of children	0.727	(0.851)	1.259	(0.951)	1.427	(0.866)	0.118***	-0.378
University education (0-1)	0.307	(0.462)	0.26	(0.439)	0.227	(0.42)	-0.049	0.069
Close friend or relative is a doctor (0-1)	0.179	(0.384)	0.189	(0.391)	0.194	(0.397)	0.009	-0.017
Health-related university studies (0-1)	0.019	(0.138)	0.026	(0.16)	0.028	(0.167)	0.01	-0.031
STEM-related university studies (0-1)	0.082	(0.274)	0.087	(0.283)	0.071	(0.258)	-0.042	-0.014
Frequency of doctor visits (1-5)	3.094	(0.801)	3.092	(0.893)	3.062	(0.981)	-0.015	0.001
Bad health status (1-5)	2.202	(0.654)	2.369	(0.76)	2.474	(0.685)	0.062**	-0.099
Saliency of vaccines in childhood (1-3)	2.43	(0.549)	2.441	(0.598)	2.411	(0.615)	-0.017	-0.007
Flu vaccine last year (0-1)	0.377	(0.486)	0.405	(0.491)	0.488	(0.501)	0.103**	-0.034
Distrust of science (1-5)	2.034	(0.753)	2.313	(0.715)	2.623	(0.654)	0.187***	-0.165
Misbeliefs on vaccines (1-5)	2.236	(0.527)	2.42	(0.706)	2.597	(0.675)	0.104***	-0.112
Believes science is too complex (1-5)	2.401	(0.754)	2.785	(1.018)	2.981	(1.064)	0.099***	-0.21
Approves medical research (1-5)	4.168	(0.811)	4.012	(0.858)	3.882	(0.769)	-0.061	0.072***
Times contracted Covid	0.514	(0.632)	0.65	(0.721)	0.692	(0.636)	0.041	-0.133
Distrusts pharmaceutical companies (0-1)	0.261	(0.44)	0.416	(0.493)	0.559	(0.498)	0.176***	-0.199

Notes: Notes: *p<0.1; **p<0.05; ***p<0.01. P-values refer to two-tailed tests for differences in means with different variances. The table shows the standardized difference in means (ASD) across several baseline characteristics between respondents with a predicted individual treatment effect from MI that is positive-significant, negative-significant, or not statistically significant. The significance of CATE estimates that categorized individuals is assessed by computing Z-scores on individual CATE estimates and comparing them to 10% critical values. For example, the cell in the first row, last column, reports that respondents who reduce their vaccine uptake after exposure to MI have, on average, 0.378 standard deviations fewer children than those who do not respond to MI, but this difference is not statistically significant.

G Robustness checks on alternative outcomes

We estimate Equation (1) on six additional outcomes to rule out that alternative channels (anchoring, emphasis on COVID-19, feelings of being patronized) drive our observed null effect of MI on flu vaccinations. The extra outcomes are (relative to the period between the two survey waves):

– **Covid-19 vaccination (0-1):** self-reported in the second survey;

- **Any medical tests (0-1)**;
- **Frequency of medical tests (1-5 Likert scale)**;
- **Flu vaccine suggestion for a third person (0-1):** we ask the following question:

  "*Consider the situation of Mario. Mario is 60 years old, lives in a big city, and in March of this year, he had surgery for a cyst on his right lung. As a result, he now suffers from respiratory failure. What would you recommend to Mario regarding the flu vaccine?*"
  Possible answers: Nothing/To get the flu vaccine/Not to get the flu vaccine/Other (open field)

  We then code as correct (= 1) the answer "To get the flu vaccine" and all open answers suggesting to consider the flu vaccine or to consult a doctor. We code as incorrect (= 0) all other answers;
- **Distrust of science (1-5 Likert scale):** We ask respondents how much they agree with five statements, invert the scales when necessary so that higher values express distrust, and take the arithmetic average (to avoid discarding respondents with missing items):

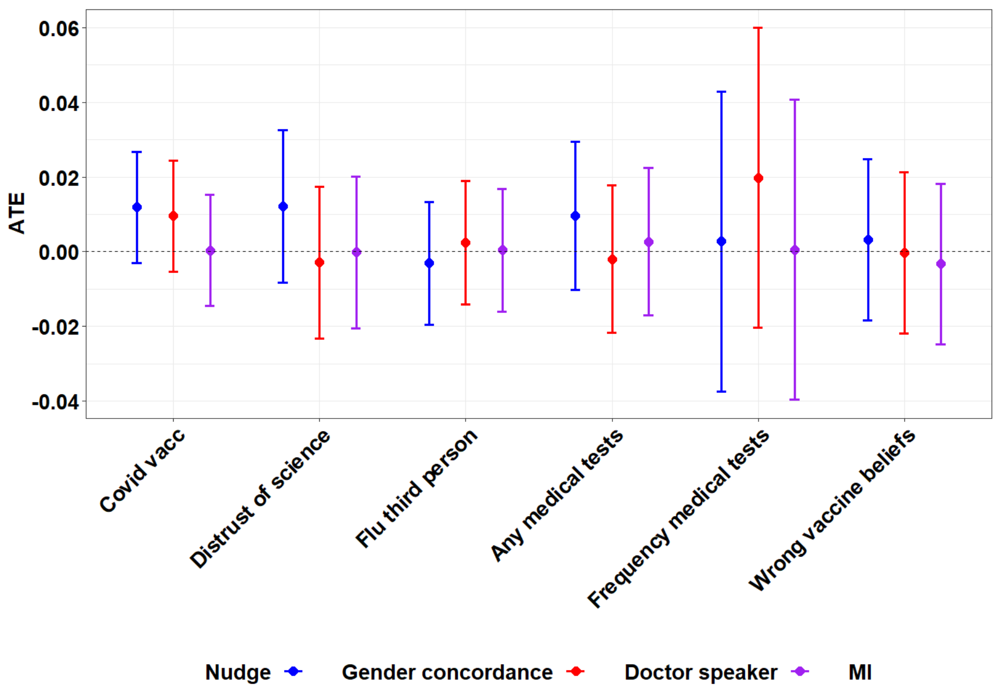
  a) Scientists ignore results that contradict their work
  b) Scientists do not take into account the ideas of others
  c) The work of scientists contributes to improving the lives of people
  d) Most scientists perform their work honestly
  e) You cannot rely on science because it proceeds too slowly
  Possible answers: not all in agreement/Slightly agree/Neither agree nor disagree/Agree to some extent/Completely agree/Don't know;
- **Wrong beliefs on vaccines (1-5 Likert scale):** We ask respondents how much they agree with five statements, invert the scales when necessary so that higher values express distrust, and take the arithmetic average (to avoid discarding respondents with missing items):

  a) Vaccines act on the immune system
  b) Vaccines often cause severe and irreversible side effects
  c) Vaccines do not protect against diseases but cause them in severe form

d) The pharmaceutical industry administers harmful treatments (e.g., vaccines) without people's consent to make them sick and increase drug sales (produced by them) Possible answers: not all in agreement/Slightly agree/Neither agree nor disagree/Agree to some extent/Completely agree/Don't know;

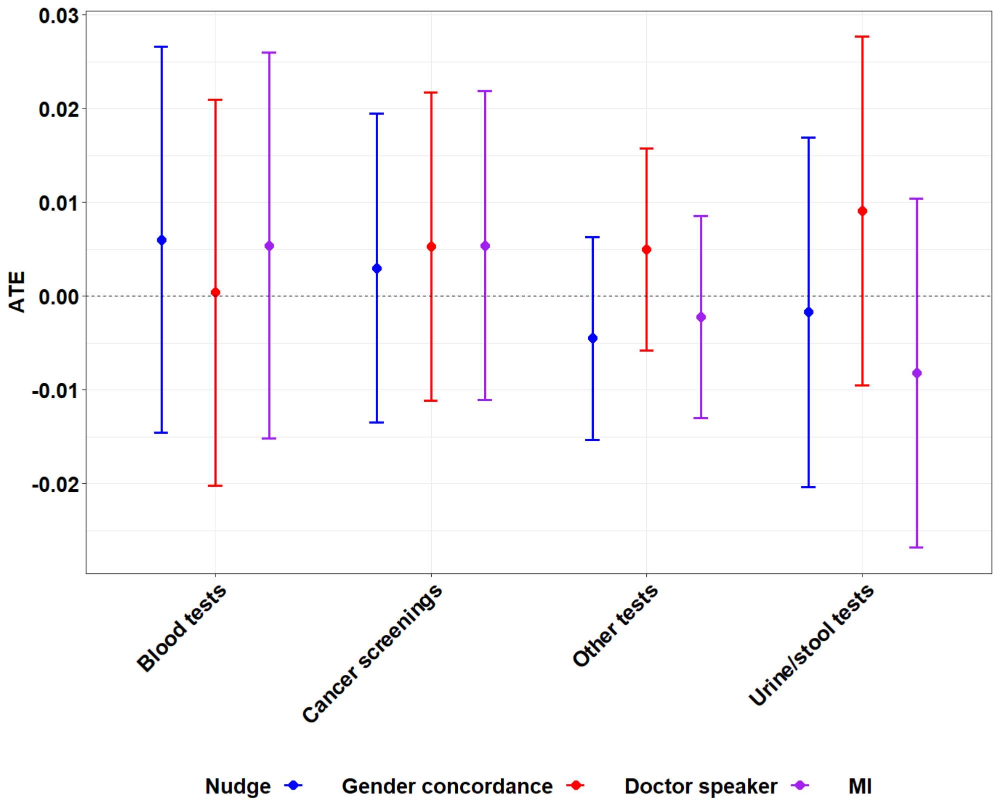
Figure G.6 reports the ATE estimates for all outcomes and for all three nudges. Figure G.7 report ATE estimates on each medical test outcome (0-1) asked in the second survey wave.

Figure G.6: Robustness checks: alternative health outcomes



Notes: the figure shows the ATE estimates and 95% confidence intervals from estimating Equation 1 on alternative health outcomes.

Figure G.7: Robustness checks: detail of medical tests



Notes: the figure shows the ATE estimates and 95% confidence intervals from estimating Equation 1 on each individual medical test we asked about in the second survey wave.

H Power Analysis

In our pre-analysis plan, we provided preliminary power calculations performed on an exploratory survey that preceded our experiment. We now update our power estimates by exploiting our baseline experiment data.

New estimates use the baseline outcome of having been vaccinated against the flu in the previous year. As this variable is used as a covariate in our analyses – and it is highly predictive of future vaccination behavior – we include here the additional covariate "anti-COVID-19 vaccine doses". Being highly correlated with baseline attitudes toward science and vaccines, this additional covariate does not match the predictive power of the previous year's flu vaccination, which makes our power estimates still conservative.

Baseline vaccination behavior is highly polarized, and less than half of our final 8310 individuals sample reports being vaccinated in the previous year (40.59%). The ultimate policy goal is reaching herd immunity: estimates suggest that only an 80% coverage in the target population suffices (Plans-Rubio, 2012), meaning that overall, the coverage in our sample should increase by nearly 40 percentage points. Given our residual variation, 80% power to detect such a huge variation is obtained with only 36 observations.

The least powered comparison we effectively perform is in our fully-saturated interaction model, which, however, includes the interaction of our 3 nudges of interest without interacting them with the receiver's gender. This implies that the triple interaction is performed over 4 treatment cells, corresponding on average to 2080 observations in the second-wave sample. Given this sample size and our residual variation, we are able to detect an effect of 3.75 percentage points with 80% statistical power. For the intention to vaccinate, measured in the first wave, 4 cells amount to 3000 observations, lowering the MDE to 3.12 percentage points.

Our most powered estimate – also the one we are most interested in – assesses the effect of a single binary treatment (e.g., MI communication) and exploits the full sample (16 cells), i.e., 8310 observations in the second wave and 12004 in the first wave. For an 80% statistical power, the MDE is 1.87 percentage points in the second wave, and 1.56 percentage points in the first wave.

Nevertheless, all our non-significant estimates are much closer to zero than the estimated MDEs, whereas our only significant estimates surpass 2 percentage points in magnitude. Therefore, we are confident that non-significant estimates are the result of true zeros rather than a lack of power.