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The importance of Social Norms against Strategic Effects: The case of Covid-19 vaccine uptake[☆]

Marina Agranov[a,*], Matt Elliott[b], Pietro Ortoleva[c]

[a] Division of the Humanities and Social Science, California Institute of Technology, United States of America
[b] Faculty of Economics at Cambridge University, United States of America
[c] Department of Economics and Princeton School of Public and International Affairs, Princeton University, United States of America

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ABSTRACT

We study how individual decisions are affected by those of other members of the society. We use the vaccine against COVID-19 as a case study and empirically estimate the magnitude of three key forces: Herding, Social Norms, and Free-riding. We find that Free-riding is dominated by the other two forces, and that Social Norms are a key driver of behavior. There is, however, substantial heterogeneity and systematic differences between people by demographics and their political preferences.

1. Introduction

Many decisions are affected by what others choose in the same situation. There are three main sources for this dependency. First, *Herding*—there is information in others' choices, e.g., we may pick the busier of two restaurants because the choice of others suggests it is better (Banerjee, 1992; Bikhchandani et al., 1992, 1998). Second, *Social Norms*—e.g., if everyone else recycles, one may feel compelled to as well (Hume, 1739; Lewis, 1969; Coleman, 1988, 1994; Ostrom, 2000; Sugden et al., 2004; Bicchieri, 2005; Young, 2008). Third, *Externalities* and *Free-riding*—e.g., the tragedy of the commons (Lloyd, 1833; Hardin, 1968; Ostrom et al., 1999).

This paper studies the conflict between these three channels in the context of decisions to take the vaccine against COVID-19.[1] These decisions are not only hugely important in the context of the ongoing pandemic at the time the data was collected; they also offer a rare case study in which there is a clear conflict between these forces. Widespread uptake of the vaccine may induce others to also take the vaccine via Herding (if others take it, it is probably because it is safe) (Broniatowski et al., 2018) or Social Norms (this is what we do as a society, to protect others) (Böhm et al., 2016; Brewer et al., 2017). But widespread adoption also *reduces* individual incentives to vaccinate: if many others take it, we may be protected by herd immunity (John and Samuel, 2000); and even if herd immunity is not reached, higher adoption means lower risk of contagion, reducing the incentives to vaccinate. To use standard economic terminology, the positive externalities in this case creates a *Free-riding* problem: citizens benefit from the vaccination of others but have lower incentives to get vaccinated themselves as more others get vaccinated (Hershey et al., 1994). Whether or not to take the Covid19 vaccine is also a salient, high-stake decision widely discussed in the media. The decision also involves a rare instance of genuine uncertainty about the safety of a vaccine (as opposed to standard vaccines, for which science-based concerns about safety are now minuscule) (Wilson and Marcuse, 2001; Dror et al., 2020; Su et al., 2020).

Our goal is to study whether the intention to take the vaccine is affected by each of these components: Herding, Social Norms, and Free-riding. To this end, we study the relationship between the stated desire to be vaccinated and beliefs about the vaccination choices of others; and how these decisions and beliefs change with information from experts.[2] This helps us to separate the role of the three effects above by showing the impact of information on behavior and on beliefs about the behavior of others. We designed our data collection to take place in the window of time

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* Corresponding author.
E-mail addresses: magranov@hss.caltech.edu (M. Agranov), mle30@cam.ac.uk (M. Elliott), pietro.ortoleva@princeton.edu (P. Ortoleva).

1 For a meta-study of the variables that predicted vaccine uptake during the global 2009 influenza pandemic see (Bish et al., 2011).

2 See Freed et al. (2011) for a discussion of experts' information about vaccinations affecting beliefs.

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in which the vaccine has been widely announced and its basic features discussed, but when the distribution had yet not begun and concerns about safety are not fully resolved—a situation with genuinely incomplete information, when these three effects are strongest.

Understanding these effects matters for policy. First, whether information coming from experts affects the propensity to vaccinate is of obvious importance for any institution interested in increasing adoption (Bogliacino et al., 2021). It is also crucial to understand how this choice is affected by the behavior of others: if Free-riding is prevalent, widespread adoption may be very hard to achieve. This also informs the choice of the optimal communication strategy: for example, broadcasting that many (vs. few) citizens are taking the vaccine has different effects depending on whether Herding, Social Norms, or Free-riding forces dominate.

2. Results

Framework. We begin by providing a framework for thinking about the decision to get vaccinated that isolates the key effects we are interested in.[3] We assume that each individual makes this choice by weighing the individual benefits and costs of being vaccinated.

The perceived cost an individual attaches to being vaccinated will depend on the individual's perceived risk that the vaccine is unsafe. For simplicity we can think about the vaccine as being safe or not safe and assume the cost of taking a safe vaccine is 0.

The benefits of being vaccinated come from two sources. First, vaccinations help an individual avoid contracting the disease. These benefits are (weakly) greater when the risk of catching the disease is higher and hence when fewer others get vaccinated. Hence, all else equal, as long as the vaccine is sufficiently effective individuals would like many others to get vaccinated creating herd immunity while not risking taking the vaccine themselves. This is the Free-riding effect. Second, there may be social pressures to get vaccinated. We assume that these pressures are (weakly) greater when more other people get vaccinated (establishing vaccination as a stronger social norm). This is the Social Norm effect.

Evaluating the costs of benefits of getting vaccinated requires an individual to try and anticipate how many others will get vaccinated and how safe the vaccine is. These two things are intertwined. The choices of others to get vaccinated or not reveals something about their perceived risks of taking the vaccine, and this might reflect information these people have (collectively) that is not available to the individual. Thus many others taking the vaccine may persuade an individual to also take the vaccine. This is the Herding effect.

Overall then both Herding and Social Norms suggest an individuals propensity to vaccinate will be increasing in the proportion of other people they expect to get vaccinated, while Free-riding suggests the opposite relationship.

Experiment. In a quasi-representative sample of 1500 U.S. citizens, we measure: (1) whether participants plan to take the vaccine if FDA-approved and available, (2) participants' beliefs about how many other respondents will say they intend to take the vaccine, (3) whether participants plan to take the vaccine if at least 60% (Treatment 1) or 90% (Treatment 2) of experts say they would take it themselves, and (4) participants' beliefs about the effects of treatment information on the behavior of others. One immediate limitation is that we only measure the stated intent to vaccinate, which may differ from actual behavior (e.g., for hypotheticality and social-desirability bias; Sheeran et al. (2013)). The questions about the behavior of others were instead incentivized: the compensation participants received depended on accuracy of their predictions, and this was clearly explained to them. In addition, we collected demographics, measures of risk attitudes, measures of overconfidence and measures of political preferences. SI.C gives a detailed description of the questions used.

[3] SI.A formalizes the following discussion by providing a decision theoretic model of the choice to get vaccinated.

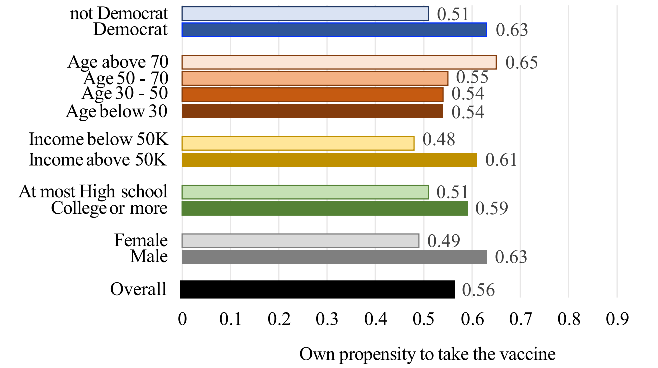

Fig. 1. Who takes the vaccine?

Premise: Who Takes the Vaccine. We start by analyzing the general propensity to vaccinate and how it relates to participants socioeconomic, political, and personal characteristics. First, we find that only 56% of participants say they plan to take the vaccine. This is remarkably stable with respect to many characteristics, as depicted in Fig. 1: while higher propensities are found for (self-identified) males, democrats, older participants, and those with higher income and higher education, the differences between groups are not very large.[4] The biggest difference is between males and females (63% vs. 49%, respectively). Regression analysis confirms these results (Table S.1, SI.B).

Relationship between own intention to vaccinate and beliefs about others' intentions. We now turn to the relationship between own uptake and beliefs about the choices of others. Is the propensity to vaccinate higher or lower the higher someone's belief that others will vaccinate? Panel (a) of Fig. 2 provides a clear answer: the fraction of participants who say they would vaccinate is strongly and *positively* correlated with their beliefs about whether others would take the vaccine: the correlation is 0.98 ($p = 0.0043$).[5] This positive relationship is confirmed by regression analysis (SI.B, Table S.2), which shows that a 10% increase in the expected proportion of others taking the vaccine is associated with an average increase in one's own propensity to vaccinate of 6.8%. In fact, we see that the two variables are not only correlated, but essentially identical for beliefs below 80%; this is confirmed statistically (SI.B, Table S.3). For beliefs above 80%, own propensity to vaccinate increases but much more slowly: we go from 63% for beliefs between 60% and 80% to only 70% for beliefs between 80% and 100%.

Interestingly, this relationship changes with respondents' (self-reported) gender and political attitudes. Panel (b) in Fig. 2

[4] Test of Proportions detects significant differences between uptake rates of males and females ($p < 0.0001$), participants of age 70 and more and younger participants ($p = 0.0100$), Democrats and non Democrats ($p < 0.0001$), respondents with income above and below 50 K ($p < 0.0001$), and participants with at least some college education versus those with at most high school education ($p = 0.0016$).

[5] This is the correlation between the average propensity to vaccinate and the average belief about the behavior of others in each belief bin separately, as depicted in Panel (a) of Fig. 2.

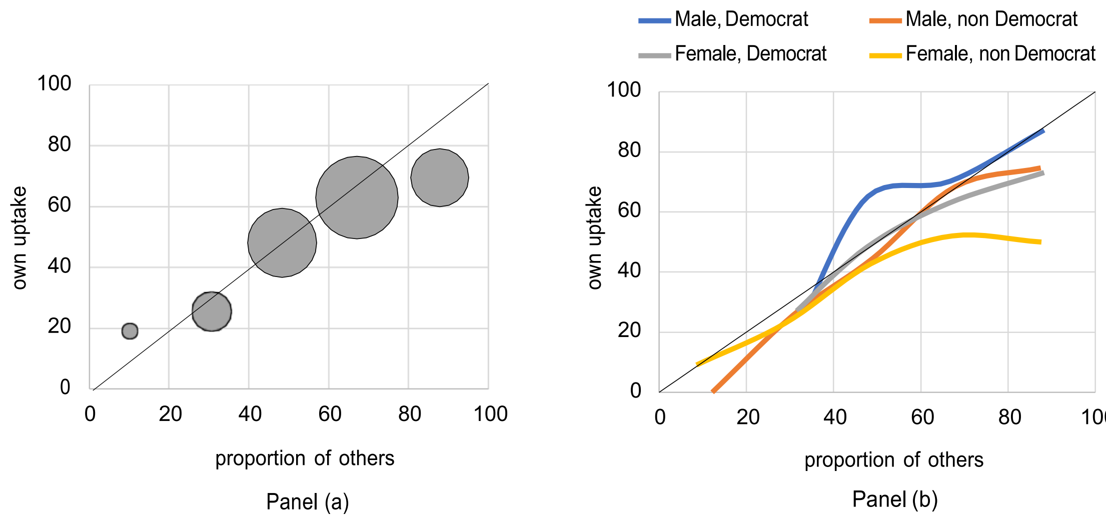

Fig. 2. Free-riding versus Social Norms and/or Information.
Notes: Panel (a): Scatter plot of fraction of subjects who say that plan to take the vaccine as a function of their beliefs about the propensity of others to take the vaccine. We group subjects by their beliefs about others into five bins (0%–20%, 20%–40%, 40%–60%, 60%–80%, 80%–100%). The size of bubbles indicates the number of observations in each category. Each bubble is centered at the average belief for that bin. Panel (b) breaks the data by gender and political attitudes. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

shows the response function broken down into four categories: male Democrats, male non Democrats, female Democrats and female non Democrats.[6] While beliefs regarding behavior of others are similar for these four groups (SI.B, Figure S.1) the difference between their uptake rates and beliefs about others are different. The most striking difference is between male Democrats (dark blue line in Panel (b)) and female non Democrats (yellow line). The former group intend to vaccinate at a rate remarkably in line with their beliefs about the rate others will vaccinate at, except for intermediate rates (for which they tend to vaccinate more). By contrast, the later group, non Democrat females exhibit a very different pattern: uptake rates are in line with beliefs about others only for low beliefs (below 40%). But vaccination rates are significantly lower than their beliefs about others for higher numbers. In fact, their vaccination rates remain stable around fifty percent for all beliefs above 40%–87% of all respondents in this group. There are also gender differences in the anti-vax movement, with females playing a disproportionate role Smith and Graham (2019). This could be related. Looking at the gap between own propensity to vaccinate and the propensity with which others are expected to vaccinate, it is interesting that it is those who believe that most others will vaccinate for whom this gap is biggest. SI.B includes a detailed statistical analysis supporting these results, as well as other demographics.

These results have immediate implications for our research question, which we examine in light of our model. A first hypothesis we can test is whether this data is consistent with neither Free-riding nor Social Norms playing a role. In this case, theory predicts that the relationship shown in Fig. 2 should be an inverted *S*-shape (Proposition 2 in the SI.A). The intuition is simple: individuals who observe information that suggests very strongly that the vaccine is safe will have higher uptake; but these agents will also recognize that they received a relatively strong signal and so will expect the uptake of others to be lower. The converse holds for individuals who have strong signals that the vaccine is unsafe—they should expected, on average, others to have a higher uptake. Fig. 2, however, is not consistent with this. (This is supported by statistical analysis presented in SI.B, Table S.3.) We therefore conclude that our data cannot be explained by Herding alone—either Social Norms and/or Free-riding play a role.

Recall that Herding and Social Norms push towards a positive relation between vaccination and the beliefs about how many others will vaccinate, while Free-riding pushes towards a negative relationship. Our results of a positive relationship show that Freeriding is *not the dominating force*. This accords with findings in Verelst et al. (2018) who also study vaccination uptake and interpret their findings as peer pressure being more important than free-riding. It is also consistent with Olive et al. (2018), which shows that low uptake of vaccinations is correlated in urban areas (see also Salathé and Khandelwal (2011) for correlations among friends).[7]

At the same time, our results do not imply that Free-riding motives are absent. Indeed, when beliefs about others' uptake are above 80%, we document own uptake rates that are significantly lower, which is consistent with the free-riding motives, since this is precisely the region where herd-immunity is more likely.[8] Yet, even in this case the relationship between uptake and the beliefs about others remains positive, showing that even in this case Free-riding does not dominate.

While this is the conclusion in the aggregate, there are significant differences in the reactions across gender and political preferences. In particular, read through the lens of our model, our results suggest the three forces balance differently for male Democrats in comparison to female non Democrats. It may be that Free-riding is stronger for female non Democrats and/or that Social Norms and Herding are weaker. It is also possible that Social Norms is reversed within some peoples' peer groups, and there is social pressure to not get vaccinated.

6 Democrats are defined as those respondents who explicitly said that their political preferences are in line with the Democratic Party or those who are leaning Democrats, 41% of our sample. Among the remaining respondents, 65% stated that their political preferences are in line or leaning towards the Republican Party.

7 In a non-vaccination context, there is also a literature showing that the tragedy of the commons (and associated externalities) can be overcome without government intervention (McCay and Acheson, 1987; Ostrom, 1990, 2009; National Research Council et al., 2002). And there is also experi- mental evidence that health behaviors spread over social networks (Centola, 2010, 2011).

8 Focusing on respondents whose beliefs about others' vaccination rate are between 60% and 80%, we find that their average belief about others' uptake is 67%, while only 63% among them plan to take the vaccine themselves. Although statistically significant, this difference is small.

Our analysis thus far shows that Free-riding is overall a weaker force than Herding and Social Norms combined. Next we turn to measuring the relative importance of the latter two by utilizing participants' responses to experts' opinions.

The effect of experts' opinion. The information about the behavior of experts has a small but significant effect on own uptake rates. As Panel (a) in Fig. 3 shows, across treatments 16% to 18% of those who declare they will not vaccinate change their mind after receiving the information about experts' choices; in contrast, 3% to 4% of those who originally declared their intention to vaccinate report the opposite after learning the experts' choices. This means that even if 90% of experts, who we define as "Doctors (MD qualification) at prestigious medical schools engaged in research on infectious diseases", demonstrate their belief in the vaccine it persuades less than 1 in 5 people not intending to take the vaccine to change their mind. While experts' support of the vaccine may in general be a complex signal to interpret, we study one of the most credible signals they can offer—taking it themselves. The lack of trust in experts may be due to a low confidence in their being truly informed, or concerns that they may be biased.[9]

There are notable difference across different sub-populations. Male Democrats are significantly more likely to change their mind and declare they would vaccinate after observing experts' choices than both male non-Democrats ($p = 0.0031$) and female non-Democrats ($p = 0.0534$). Overall, we detect a significant but modest effect of providing information about experts' behavior on the own declared uptake rates from 53% to 57% in Treatment 1 (Experts60) and from 58% to 63% in Treatment 2 (Experts90). (Wilcoxon Signrank test of matched observations, $p < 0.0001$ in both treatments.)

Despite a relatively small overall effect on their own reported uptake of the vaccine, subjects anticipate a stronger reaction to this information by others. Panel (b) in Fig. 3 shows a substantial shift in the cumulative distribution functions representing the beliefs that others will get vaccinated after receiving information about experts' choices. Interestingly, there is no significant difference between the two treatments.[10]

We now turn to the interpretation of these results in light of our model. We have established that Herding or Social Norms together dominate Free-riding. We now discuss the relative importance of the former two. To perfectly isolate the different mechanisms, we would need to shift exogenously and independently the beliefs about the underlying social norm and the riskiness of the vaccine, which is not what we do. However, we will now argue that the reaction to experts' opinions can be nevertheless be informative on this point.

The key empirical finding that facilitates this is that our subjects' response to expert advice is essentially the same and statistically indistinguishable across the cases in which (a) 60% of experts take the vaccine; and (b) 90% of experts take the vaccine. As there is very little difference between the impact of this information upon across the two treatments, either (i) there cannot be much difference in the perceived information being conveyed; or (ii) such information cannot be an important factor in determining individuals' propensity to vaccinate. In the former case, as experts' vaccination decisions do not contain much information, neither should choices in the broader population. But then herding cannot be playing a substantial role. In the latter case, information is not an important factor for subjects' own propensities to vaccinate, and so again herding cannot be playing a substantial role.[11]

While the above argument just suggests that Herding is unlikely to be playing a prominent role,[12] it is notable that Social Norms alone can explain all the key trends we observe in the data regarding the experts' treatments (as well as the key trends in the rest of our data). How are Social Norms affected by experts' choices? First, there may be a direct effect—the opinion of experts may affect that individuals think they ought to do (so-called 'prescriptive' social norms). Second, there can be an indirect effect: if an individual expects others to respond to the information from experts, then that individual will expect vaccination rates to increase in the population as a whole, which increases the cost of violating the social norm by not getting vaccinated; that is, experts' opinions affect what others actually do, and thus the social-norm (a 'descriptive' social norm).[13] As this effect is only indirect it will be relatively weak and we would expect, all else equal, for people's own propensity to vaccinate to increase substantially less than they expect others' propensity to vaccinate to increase. This is precisely what we see in the data.[14]

3. Discussion

We investigate how the anticipated choices of others affects individual decisions, focusing on a case of particular relevance: the choice to vaccinate against COVID-19. We study three channels through which others' choices might matter: Herding, Social Norms and Free-riding. Our results show that Free-riding is in aggregate dominated by some combination of the other two, while the responses of people to information about the propensity of experts – doctors researching infectious diseases – to vaccinate suggests that Herding based on the information contained in others' choices also plays a limited role. In contrast, Social Norms alone are capable of explaining all the key trends in our data.

First, Social Norms predict the positive relationship we find between individual propensity to vaccinate and their expectations about the vaccination rate in the population as a whole. Second, Social Norms are consistent with the S-shaped curve we observe in Panel (a) of Figure S.2 (as well as other possible relationships). It is plausible that Social Norms have little impact when the uptake of others is expected to be low, which means that people's own propensity to uptake increases at a rate less than 1:1 with the expected propensity of others. Then, at intermediate levels above the expected propensity of others to vaccinate, Social Norms become more important, before flattening out when expectations of others vaccinating is very high—after all, at such levels one may expect to have herd immunity, making vaccination choices less salient. Indeed, it is at

9 Experts are also ineffective at changing peoples' opinions about the economic outlook (Agranov et al., 2021).

10 The total uptake rate of others is computed using both the original belief about others' uptake before information and reported fraction of respondents that would change their minds as a result of experts' information. Table S.7 in SI.B investigates the respondents' characteristics which correlate with respondents' beliefs about how many people will change their mind as a result of the informational treatment.

11 Note that this argument does not rely on us taking a stand about whether expert choices represent positive or negative information about how safe the vaccine is when 60% or 90% of experts take it. The same reasoning applies in both cases.

12 The relatively small magnitude of the effect that experts' decisions have in both our two treatments is also consistent with a generally limited impact of Herding.

13 Social norms may be 'prescriptive' (what we ought to do) and/or descriptive' (what we actually do). The relevance of the behavior of others in compliance suggest the importance of widespread adoption. Social norms also depend on the reference groups: while here we focus on the general population, for some individuals the relevant behavior may be that of a specific subgroup.

14 We should note, however, a difference in measurement: individuals' own behavior is measured with a binary variable, while beliefs about the behavior of others are measured more continuously; this may be playing a role in (although not fully explain) the difference in the effects.

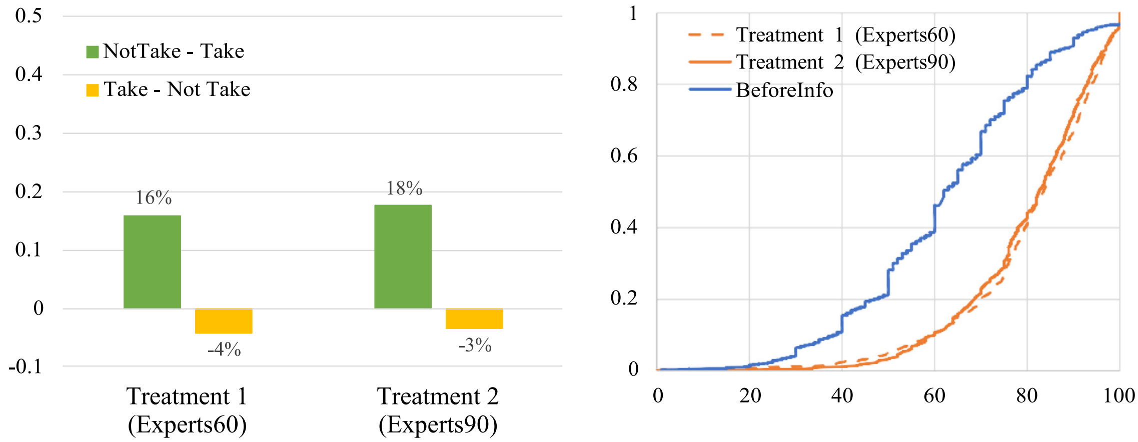

Fig. 3. Social Norms or Herding?
Notes: Panel (a) depicts the percentage gain in the own uptake of the vaccine among those who declared not taking the vaccine before receiving information about experts (green bars) as well as the percentage loss among those who declared intention to take the vaccine (orange bars) in both treatments. Panel (b) plots the cumulative distribution functions (CDFs) of the beliefs about the total number of people taking the vaccine both before and after receiving information about experts. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

relatively high, but not the highest levels of vaccination, that we may expect Social Norms to be most relevant.

As we have already discussed, Social Norms alone can also explain the weak but statistically significant responses to information about experts' propensities to vaccinate, while at the same time the fact that the same people expect others' to be more affected by the same information. People are positively influenced by the decisions of others to vaccinate; not because they find information in this choice, but because they expect others to respond to it. As this channel is indirect, it is consistent with the relatively small impact information about experts' choices has, and with individuals expecting others to be more responsive than they themselves are.

Our study is subject to some immediate limitations. Most prominently, we study the correlation between beliefs and behavior, which we interpret in light of our model, and not their causal relationship directly: thus, when we document that vaccination rates are higher for subjects who believe a higher proportion of others will vaccinate, we cannot conclude that a change in the latter would induce a change in the former. The only causal manipulation is our treatment about the behavior of experts; a similar treatment on the behavior of peers, however, would be problematic: since we are interested in studying Social Norms, these are harder to manipulate.[15]

A case study on the vaccine of COVID-19 is of particular policy relevance today, and could be informative of general attitudes towards experimental vaccinations, an issue of potentially increasing relevance in the future. From a policy perspective, our results suggest that policy makers can worry less about Free-riding, but should instead try to establish Social Norms of behavior: promotional messaging may thus emphasize how widespread the adoption is, instead of expressing concerns about groups that refuse to, while focusing on messages of social responsibility rather than individual benefits. At the same time, our results highlight how some demographics may either be more susceptible to Free-riding or less susceptible to Social Norms; to the extent to which policy makers engage in targeted messaging, they may want to present different approaches to these groups. Last, our finding that the behavior of experts has little effects in changing minds is rather sobering and suggests that information campaigns might want to focus less on this aspect.

4. Methods

The survey was conducted online and administered by *Qualtrics*. The sample consists of a quasi-representative sample of 1500 U.S. citizens stratified by gender, age, education, and income with quotas corresponding to the 2018 American Community Survey.[16,17]

The survey consisted of two parts. In Part I, respondents provided demographics information (age, gender, education, income, postal code of their main residence), attitudes towards risk, political preferences, and answered a few questions used to estimate their overconfidence. Part II was the main part of the survey and consisted of 12 questions in total. Four of these questions were about vaccination and they are the main data we use in this study. The remaining eight questions are unrelated to the current study and they asked subjects to indicate their guesses about several economic variables.

To incentivize subjects to report their best guesses in all questions in Part II, at the end of the survey the computer selected 10% of the participants at random. The selected participants received additional rewards that depending on how accurate their predictions about others were in a randomly selected question from the survey. Thus, respondents were incentivized to report their best guesses. Average completion time for the whole survey was 8 min 51 s. SI.C presents the exact formulation and discusses design choices.

15 Note that simple models of reverse causality are hard to generate. First, it cannot be the case that those who vaccinate believe everyone else will; rather, the fraction of vaccination rates tracks the beliefs about others. Second, the behavior we observe is not compatible with a model in which agents learn about the state of the world and use this to infer what others will do. As we discuss in SI.A, this model would generate a relationship between own propensity to vaccinate and beliefs about others that is inconsistent with the relationship we find (Figure S.1). Of course, we cannot rule out an omitted variable is causing the observed relationship.

16 http://www.census.gov/programs-surveys/acs/news/data-releases/2018/release.html.

17 In particular, our sample contains 51% of females and 49% males; 32% of respondents of age between 25 and 34, 37% of respondents of age between 35 and 54 years old, and 31% of respondents above 54 years old; 39% of respondents with at most high school education or less, 26% with some college education, 21% with college degree and 13% with graduate or another advanced degree; 40% of respondents with income below 50 K, 30% with income between 50 K and 100 K, and finally 30% with income above 100 K.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.econlet.2021.109979.

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