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Anticipation of COVID-19 vaccines reduces willingness to socially distance ☆

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ABSTRACT

We investigate how the anticipation of COVID-19 vaccines affects voluntary social distancing. In a large-scale preregistered survey experiment with a representative sample, we study whether providing information about the safety, effectiveness, and availability of COVID-19 vaccines affects the willingness to comply with public health guidelines. We find that vaccine information reduces peoples' voluntary social distancing, adherence to hygiene guidelines, and their willingness to stay at home. Getting positive information on COVID-19 vaccines induces people to believe in a swifter return to normal life. The results indicate an important behavioral drawback of successful vaccine development: An increased focus on vaccines can lower compliance with public health guidelines and accelerate the spread of infectious disease. The results imply that, as vaccinations roll out and the end of a pandemic feels closer, policies aimed at increasing social distancing will be less effective, and stricter policies might be required.

1. Introduction

Several COVID-19 vaccines have shown high effectiveness, and the vaccine programs launched earlier than anticipated (Gaebler and Nussenzweig, 2020; Krammer, 2020). Yet, during the rollout of the vaccines, the global spread of COVID-19 has continued and governments urgently ask citizens to respect social distancing recommendations, such as avoiding in-person contacts and staying home when sick. At the same time, encouraging news about vaccines receive wide coverage in the media, instilling hope that the pandemic will soon be over.

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Knowing whether and how the good news about COVID-19 vaccines affects social distancing behavior is crucial to assess the effectiveness of social distancing policies. On the one hand, the prospect of a vaccine means that more careful behavior now will not just delay infection of oneself or others but may prevent infection entirely. Getting information about COVID-19 vaccines may thus foster social distancing if people realize that they only have to make one last effort to avoid infection (Eichenbaum et al., 2021; Makris and Toxvaerd, 2020). On the other hand, a large literature shows that optimism and good mood reduce perceived risks (Lerner et al., 2015), leading to more risk-taking (Cohn et al., 2015; Haushofer and Fehr, 2014; Meier, 2019, 2021). If the encouraging news about vaccines make people optimistic and less worried about the pandemic, vaccine anticipation can reduce social distancing. Hence, whether new vaccine information increases or reduces social distancing is an open and important question.

In a preregistered survey experiment, we show that getting information about COVID-19 vaccines and their effectiveness reduces people's willingness to socially distance and their willingness to stay at home. Importantly, we also document that good news about COVID-19 vaccines shifts peoples' beliefs about the pandemic: People become more optimistic when they learn about vaccines, thinking that the pandemic will be over sooner. To illustrate how such a vaccine anticipation effect could translate into COVID-19 cases, we estimate counterfactual scenarios in the absence of vaccine anticipation and in the absence of vaccines. We conclude that, by July 2021, up to half of the positive effects of the vaccines on COVID-19 cases in Sweden could have been offset by the reduced social distancing generated by the vaccine anticipation.

Taken together, we find that learning about vaccines makes people optimistic and less vigilant about the virus. This vaccine anticipation effect may partly explain why many countries have struggled to curb infections, as positive news about the vaccines have filled the headlines. The findings also suggest that the tone and extent of vaccine communication from governments and the media can shape adherence to social distancing recommendations. Perhaps most importantly, our findings highlight that social distancing policies aimed at stopping the spread of the virus will likely be less effective as vaccination programs roll out. Stricter policies might instead be needed as the end of the pandemic starts feeling closer.

We run a large-scale online survey experiment with a representative sample of the Swedish population ($N = 1{,}617$). Using Swedish data is ideal for the purpose of studying social distancing behavior because, despite having similar COVID-19 cases per capita as the US and other European countries, fewer mandatory restrictions were in place at the time of data collection. This allows us to study an array of social distancing behaviors, such as avoiding traveling and wearing a face mask, that are fundamental to avoid the spread of the virus. Moreover, Swedes have similar vaccination perceptions to citizens of many other Western countries, such as Germany, the UK, and the US (de Figueiredo et al., 2020).

We collected the data between December 10 and 13, 2020, as the first vaccinations with the Pfizer-BioNTech (BNT162b2) COVID-19 vaccine were taking place in the UK. We measure participants' social distancing and hygiene behaviors using ten different intended health behaviors, including maintaining physical distancing, washing hands, and staying at home when sick. We further run a choice experiment where we ask participants whether they would be willing to stay at home under different scenarios, varying the number of weeks they would have to stay at home, the number of hours per week they would be allowed to go outside, and a potential compensation.

Participants in the treatment group are informed about the newly developed COVID-19 vaccines *before* answering questions about their intended health behaviors and willingness to stay home. In particular, we inform them that some vaccines are more than 90% effective, that vaccination has already begun in some countries, and the EU timeline for approving vaccines. In contrast, participants in the control group receive the vaccine information *after* answering the questions about their intended health behaviors and willingness to stay home. We then compare the health behaviors and willingness to stay home between participants who got the vaccine information before answering the questions, the treatment group, with those who got the information after, the control group.

The effectiveness and rollout of vaccinations cannot be changed by researchers. However, the perception thereof can be changed by providing information on the effectiveness and the rollout of vaccinations (Haaland et al., 2021). We do this in our experiment by providing information similar to the one provided in the news about COVID-19 vaccines. Like newspaper articles, our treatment may affect beliefs about vaccines' effectiveness, trust in vaccines, beliefs about the vaccination rollout, and perceptions of when the pandemic ends. The treatment may also, like newspaper articles, affect the salience of certain aspects of the pandemic and the vaccine development.[1] While we observe that vaccine information makes people believe the pandemic will be over sooner, our experiment is not specifically designed to assess the relative importance of different mechanisms. We therefore call the treatment effect a "vaccine anticipation effect" as the treatment likely manipulates both salience and information (see e.g., Cohn et al., 2015; Haaland et al., 2021).

As with most survey studies, one concern of using self-reported measures is that experimenter demand effects may drive part of the results (Rosenthal, 1966; Zizzo, 2010; de Quidt et al., 2018). However, we believe that several aspects of our study design alleviate this concern. First, the link between the information provided in the treatment condition and the actual outcomes is not particularly salient. The treatment gives information about vaccinations that will roll out in the future, and does not make any direct connections to the imminent health behaviors: We do not mention social distancing behaviors in the treatment and we do not mention vaccinations when measuring willingness to socially distance. Second, it is not clear why participants would think that the experimenter expects those in the treatment group to reduce their compliance. In fact, models based on forward-looking agents (e.g., Makris and Toxvaerd 2020) typically predict an increase in the willingness to socially distance, rather than the decrease we find. Last, in a previous study we validate the measures that we use by showing that they correlate strongly with actual observed behaviors, such as buying a mask

[1] See Haaland et al. (2021) for a detailed discussion on the design and impact of information provision experiments.

Table 1
Treatment arms overview.

	Order of appearance of question blocks 1	2	3	4	5	Share of participants
Treatment	Vaccine info.	Duration	Choice experiment	Health Behaviors	Survey	0.5
Control A	Choice experiment	Health behaviors	Vaccine info.	Duration	Survey	0.25
Control B	Choice experiment	Health behaviors	Duration	Vaccine info.	Survey	0.25

Note: The order of questions about the stay-at-home program and health behaviors is randomized in all treatments.

and seeking information about the pandemic (Campos-Mercade et al., 2021). Similarly, in the data collected in our experiment here, we find that a 1 standard deviation higher reported adherence to public health guidelines relates to a substantial 7 percentage point reduction in the likelihood of having had COVID-19 ($p<0.01$).

By documenting the impact of vaccine anticipation on health behaviors and pandemic beliefs, we complement an interdisciplinary literature that aims to understand how behavioral factors contribute to the spread and prevention of COVID-19 infections (Bavel et al., 2020; Betsch, 2020; Betsch et al., 2020; Briscese et al., 2020; Campos-Mercade et al., 2021; Cappelen et al., 2021; Charoenwong et al., 2020; Clinton et al., 2021; Galasso et al., 2020; Gollwitzer et al., 2020; Bartscher et al., 2021; Müller and Rau, 2021; Thunström et al., 2020). We also add to a large literature studying the role of psychological factors and economic preferences in shaping health behaviors (Betsch et al., 2017, 2010; Brewer et al., 2017; Galizzi et al., 2018; Harris et al., 2010; Korn et al., 2020; Lau et al., 2019; Maurer et al., 2009; Milkman et al., 2011; Schilbach, 2019). Last, we build on previous findings which document important effects of news and information on people's beliefs and behavior in general (Akesson et al., 2020; Armona et al., 2019; Haaland and Roth, 2020; Marreiros et al., 2017; Roth and Wohlfart, 2020) and particularly during the COVID-19 pandemic (Ajzenman et al., 2020; Bursztyn et al., 2020; Fetzer et al., 2020; Simonov et al., 2020).

2. Design

This section contains information about the study design, sample, and statistical analysis. The study was preregistered at the OSF registry (https://osf.io/6wsg7/).

2.1. Data collection and sample

We invited a representative sample of the Swedish population (in terms of age, gender, and counties) to participate in an online survey experiment. The invitations were sent out by the company Enkätfabriken on December 10–13, 2020 via email and the survey was administered online.

We obtained 1,617 responses. Descriptive statistics of the sample are presented in Table S1. In comparison with the Swedish population, our sample is representative with respect to gender, age composition, and geographic location of households (see Table S13).

2.2. Survey and experimental design

The survey has five parts: Vaccine information (Vaccine info.); Pandemic duration questions (Duration); Choice experiment capturing the willingness to participate in stay-at-home programs (Choice experiment); Health behaviors (Health behaviors); Additional survey questions (Survey). The experiment has three treatment arms that differ only in the order in which the different parts of the survey were presented to the participants. Table 1 shows the sequence of question blocks used across the three treatments and the share of participants randomized into each treatment.

The main treatment variation comes from the placement of vaccine information with respect to the health behaviors and stay-at-home questions. In the analysis, we compare participants' responses on health behaviors and willingness to participate in stay-at-home programs between participants who received vaccine information before (Treatment) vs. after responding to the questions on health behaviors (Control A and B). There are no differences in covariates between participants in the treatment and control group, which suggests no systematic attrition (see Table S2 in the Supplementary Materials).

In all three treatments, the order of health behaviors and the choice experiment blocks are randomized. Information about the specific parts follows below, and Section 2 of the Supplementary Materials contains the exact wording of all questions and information provided in the survey. In the following, we describe each block of the experiment.

2.2.1. Vaccine info.: vaccine information intervention

In this part, we inform subjects about recent news concerning the efficacy of the vaccine, that vaccination already started in the UK, and the likely timeline of vaccine roll-out in Sweden. After receiving the vaccine information, participants answer questions intended to make sure they had read the information.

2.2.2. Duration: pandemic duration questions

We ask two questions on how participants assess the duration of the pandemic. The first question asks whether they agree (on a 7-point scale) to the following statement: *"In February 2021, life will to a large extent be back to how it was in February 2020, before the outbreak of the pandemic."* The second question asks: *"In how many months do you think the restrictions imposed by the coronavirus will be removed? That is, when do you think life returns to normal in Sweden?"* (with possible answers ranging from 1 to 24 months). We ask these questions to investigate if the vaccine information affects participants' beliefs and optimism about the duration of the pandemic.

2.2.3. Choice experiment: experiment capturing the willingness to participate in stay-at-home programs

We measure participants' willingness to stay at home using a discrete choice experiment. We ask participants whether they would voluntarily participate in a self-isolation program in which the government would ask them to stay at home for a number of weeks. Nine different scenarios are presented in which we vary the length of the stay-at-home policy, the number of non-working hours they would be allowed to leave their homes, and a potential compensation for participating in the program. The design of the choice experiment is similar to the one used in Andersson et al. (2021).

The primary outcome variable from this part is the average probability of a participant's (binary) decision to participate (or not) across the nine different proposed stay-at-home programs. We take the average probability and then standardize it, to make it comparable to the health behavior measures. We show results using the non-standardized version and probit regressions in the Supplementary Materials (Tables S10 and S11).

2.2.4. Health behaviors

In the health behaviors part, we collect information on ten different behaviors that are important for reducing the spread of COVID-19. They are divided into two sets of questions.

In the first set of questions, we ask participants to look ahead and state to what degree (on a scale from 1 to 7) they will follow seven social distancing and health behaviors: *i*) avoiding social contact; *ii*) informing themselves about how the spread of the coronavirus can be prevented; *iii*) keeping at least two meters distance from other people; *iv*) refraining from domestic travels; *v*) coughing and sneezing into the elbow or a tissue; *vi*) touching their face less often, and *vii*) washing hands more often than usual when not at home.

In the second set of three questions, we ask participants to consider a situation in which they exhibit mild symptoms of illness (e.g., coughing) tomorrow. The participants are then asked to state to what degree (on a scale from 1 to 7) they would in the next two weeks: *i*) self-quarantine; *ii*) immediately inform people with whom they had contact with; *iii*) wear a mask or something else to cover their mouth (e.g., a scarf) if they had to leave home.

We standardize each single item for the analysis and then average across all single items to build a health behavior index. These measures are correlated with actual observed behaviors, such as buying a mask and seeking information about the pandemic (Campos-Mercade et al., 2021), as well as with the probability of having had COVID-19 (Figure S4). In the Supplementary Materials, we show the main results using each single item in Tables S3-S7 and using the principal component of health behaviors in Table S12. The results are very consistent across all measures.

The last part of the survey contains three additional blocks of questions. One block is related to COVID-19, containing questions about participants' beliefs, worries, and views on the Swedish response to the pandemic. Another block collects information about socioeconomic status, such as age, education, gender, and housing. The final block measures risk, time, and social preferences using the well-established questions from Falk et al. (2018) and political values.

3. Results

3.1. Main result: Anticipation of COVID-19 vaccines reduces social distancing

Providing information on the availability and effectiveness of vaccines reduces social distancing. Fig. 1 shows the treatment effects from a regression of each outcome on an indicator taking the value 1 if a participant got the information about the vaccine before answering the questions about health behaviors and willingness to stay at home and 0 otherwise. The regressions control for the preregistered battery of socioeconomic and socio-demographic variables[2] and the coefficient estimates give the change in the outcome variable in standard deviations. Using the health behaviors index shows that health behaviors are less compliant with the public health recommendations when participants receive information about vaccines (p<0.01). The coefficient estimates for each single behavior (non-bold-faced) confirm that this result comes from a uniform shift across behaviors. Giving information about vaccines reduces desirable health behaviors by 0.13–0.25 of a standard deviation. For example, treated participants are 0.2 of a standard deviation less likely to self-isolate if they would exhibit symptoms of illness tomorrow than participants in the control group.

Vaccine information also reduces people's willingness to participate in a stay-at-home program (Stays home), which we measured in a choice experiment containing nine different scenarios (see Figure S2 for a histogram of the willingness to participate). Vaccine

[2] Following our preregistration protocol, the main model includes the following covariates: a gender dummy, age dummies (39–39 years, 40–49 years, 50–59 years, 60–69 years, ≥70 years), Income per adult, Employed, University studies, One adult in the household, No kids in the household, Big city (>300,000 inhabitants), City (<300,000 and >50,000 inhabitants), Small city (<50,000 inhabitants). Across all regressions we estimate heteroscedasticity robust standard errors. See Table S1 for the summary statistics of all variables.

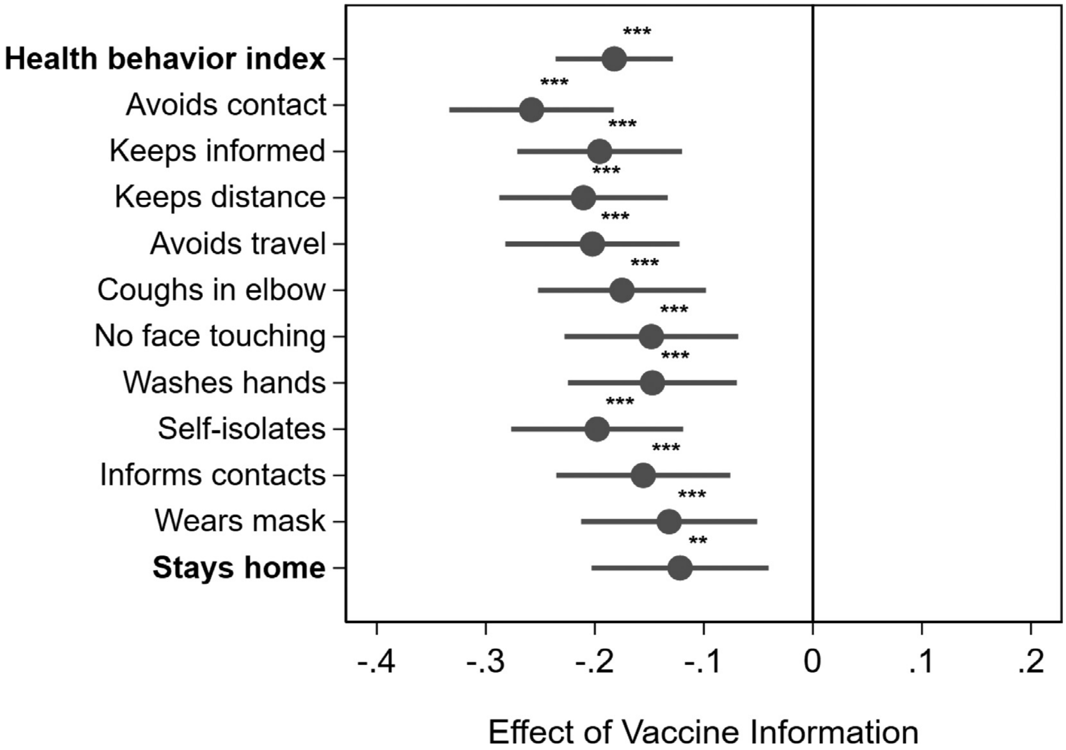


Fig. 1. The treatment effect by intended health behavior. The gray dots give the estimated difference on the outcome variables in standard deviations when comparing people who receive the vaccine information after describing future health behavior (Control) to people who receive vaccine information before describing future health behavior (Treatment). The health behavior index captures an average of the following standardized health variables. The first seven non-boldfaced measures are responses to the following questions: “Looking ahead, to what extent do the following statements describe your behavior in response to the outbreak of the coronavirus (COVID-19)?”: Avoids contact “I will try to avoid social contacts in person (for example, I will attend fewer social gatherings)”; Keeps informed “I will inform myself about how the spread of the corona virus can be prevented”; Keeps distance “I will keep at least two meters distance from other people”; Avoids travel “I will refrain from private domestic trips outside my home municipality (e.g., to holiday homes and acquaintances)”; Coughs in elbow “I will cough and sneeze into my elbow or a tissue instead of the hand”; Not touching face “I will touch my face less often than usual”; and Washes hands “I will wash my hands more often than usual when not at home”. The three remaining measures are responses to the following questions: “If you exhibited mild symptoms of illness (e.g., coughing) tomorrow, how much do the following statements apply to your behavior in the next two weeks?” Self isolates “I will self-quarantine”; Informs contacts “I will immediately inform people who had contact with me”; and Wears mask “I will wear a mask, or something else to cover my mouth (e.g., a scarf), if I have to leave home”. (Answers on 7-point scale ranging from 1= "Does not apply at all" to 7= "Applies very much"). Stays home refers to the probability of people voluntarily participating in a stay-at-home program across 9 scenarios (ranging from people taking part no matter what the conditions of the stay-at-home program are, to never taking part) which is standardized to be comparable to the other measures (see section Materials and Methods for details). As preregistered, the coefficient estimates are based controlling for gender, 6 dummies indicating age categories, adult income, a dummy indicating unemployment, a dummy indicating children, a dummy indicating single households, a dummy indicating a university degree, and dummies indicating whether people live in a big city/regular city/small city. We present the full set of results for each single item with and without controls in Tables S3-S7. Figure S6 shows that the results are equivalent when we drop individuals who filled out the survey in less than 5 min. *** p<0.01, ** p<0.05, * p<0.1.

information reduces the likelihood of staying at home by 0.12 of a standard deviation, which corresponds to a 4-percentage point lower likelihood to participate in any stay-at-home program (p<0.05, see Table S10 for the results using probit regressions instead of linear regressions and including scenario-specific controls, as well as Table S11 for the results from linear regressions with the non-standardized outcome). Taken together, all our measures indicate that providing information on the availability and efficacy of vaccines has detrimental effects on health behaviors that are key for slowing the spread of the virus.

Table 2 shows the regression results for the two main outcomes with and without socio-demographic controls. The treatment effect estimates for the impact of vaccine information on health behaviors and willingness to stay-at-home are statistically significant and sizable across all specifications. Regression results for each single health-behavior item are displayed in Tables S3-S7 of the Supplementary Materials. Additional specifications presented in Table S14 suggest that interaction effects with respect to individual preferences (risk attitudes and patience) are at best modest.

Table 2
Treatment effect on the main outcome variables.

Dependent variables:	Health behavior index			Stays home		
	(1)	(2)	(3)	(4)	(5)	(6)
Vaccine Information	−0.19***	−0.19***	−0.18***	−0.12**	−0.11**	−0.12**
	(0.04)	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)
Observations	1,617	1,617	1,617	1,617	1,617	1,617
R-squared	0.02	0.16	0.17	0.00	0.02	0.02
Gender		Yes	Yes		Yes	Yes
Age Categories		Yes	Yes		Yes	Yes
Controls			Yes			Yes

Note: The table shows the treatment effect estimate for people receiving vaccine information on health behaviors using linear regressions. Higher values in “Health behavior index” indicate better intended health behaviors to stop the spread of the virus. Stays at home indicates a higher willingness to stay at home for the different scenarios in the choice experiment. Age categories include 6 indicators for age categories. Controls include adult income, a dummy indicating unemployment, a dummy indicating children, a dummy indicating single households, a dummy indicating a university degree, and dummies indicating whether people live in a big city/regular city/small city. Heteroscedasticity robust standard errors are shown in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

3.2. Vaccine information makes people think the pandemic will be over sooner

One reason for the change in behavior could be that when people learn about COVID-19 vaccines, they become more optimistic and feel more upbeat about the pandemic ending soon. In line with our preregistration, we investigate if the vaccine information affects the beliefs about the duration of the pandemic using two survey items. The first item measures people’s beliefs about whether life will begin starting to look like normal in two months (February 2021), and the second elicits beliefs about the remaining duration of the pandemic in months (see Figure S3 for histograms of the items). By comparing answers for participants in the Control group who answered the questions before vs. after receiving the vaccine information, we can estimate the causal effect of vaccine information on their beliefs about the duration of the pandemic and when life will return to normal (for further results see Tables S8 and S9).[3] Fig. 2 shows the responses for participants who received the information on vaccines in blue and for participants who did not receive the information in gray.

When participants receive vaccine information before estimating the length of the pandemic, they think that the pandemic will be over sooner. Treatment effect estimates from regressions confirm the visual impression in Fig. 2 for both variables. Receiving vaccine information increases the likelihood that participants think life will start going back to normal in February by 0.15 of a standard deviation ($p<0.05$) (see Table S8). Examining the expected duration in months, we see a qualitatively similar albeit statistically insignificant shift: People with vaccine information tend to think the pandemic will be over sooner (Figure S5 and Table S9). The regressions include the same sets of covariates as outlined in the main regressions above.

The evidence suggests that people become more optimistic when learning about upcoming vaccines. Moreover, explorative analyses suggest that the optimistic beliefs about the duration of the pandemic correlate with less compliant health behaviors in the raw data ($p<0.05$). Taken together, these findings suggest that vaccine news cause optimism about the end of the pandemic, which in turn leads to more risky behaviors.

4. Potential scenarios of COVID-19 spread in Sweden in the absence of vaccine anticipation

Here we use a retrospective scenario analysis based on actual case numbers to illustrate how vaccine anticipation could have affected COVID-19 cases in Sweden. We construct the scenarios assuming that changes in health behavior translate to changes in mobility, which in turn affect the number of cases, using the estimated impacts of mobility on cases reported in Zhou et al. (2020). Furthermore, we assume that the first positive news on COVID-19 vaccines in November lead to a vaccine anticipation effect that built up between November and December. For details and sensitivity analyses, see Supplementary Materials, Section 3, and Figures S7-S9.

Fig. 3 shows different retrospective scenarios based on these assumptions. In the top panel, the blue dashed line depicts a potential development of cases in the absence of vaccine anticipation, while the black solid line shows the official weekly COVID-19 cases in Sweden between September 2020 and July 2021. The comparison between actual cases and the potential development of COVID-19 cases without vaccine anticipation suggests that cases could have been considerably lower without vaccine anticipation. The bottom panel plots the corresponding cumulative cases and estimates that, while by the end of July there had been 9719 cases per 100,000 inhabitants detected in Sweden since September, the counterfactual scenario without vaccine anticipation would have led to 9,214 cases, a reduction of about 5%.

[3] As preregistered, we focus on the comparison between Control A and Control B, but the results are consistent when we use the full sample, see Tables S8 and S9 in the Supplementary Materials.

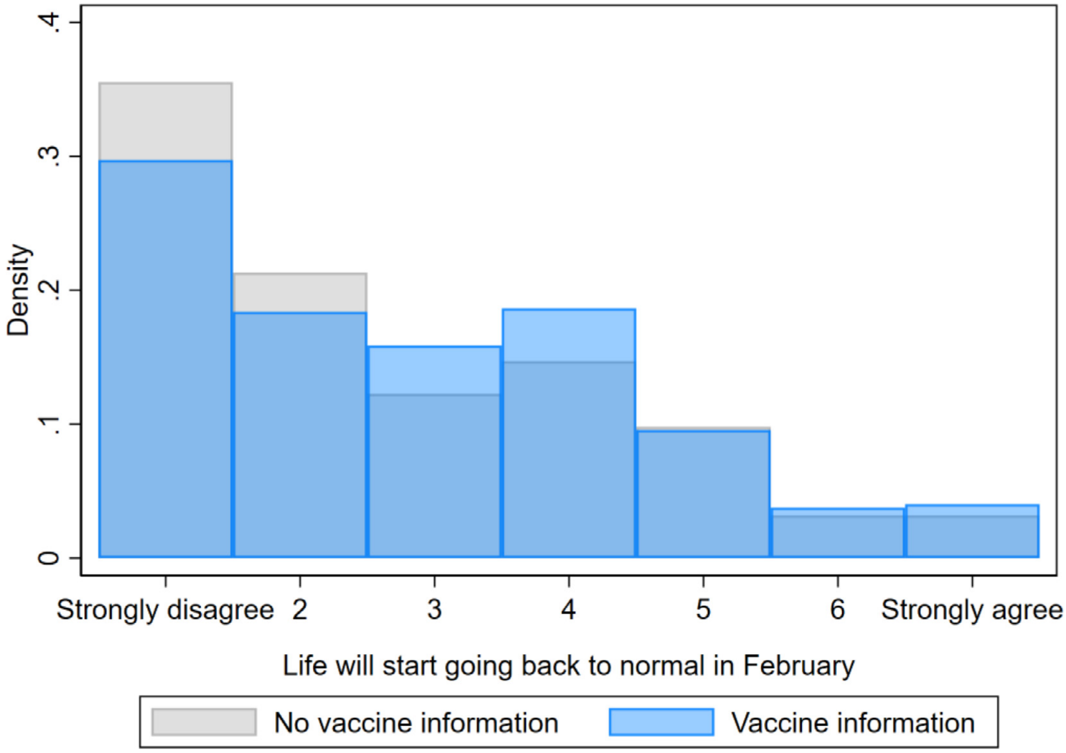


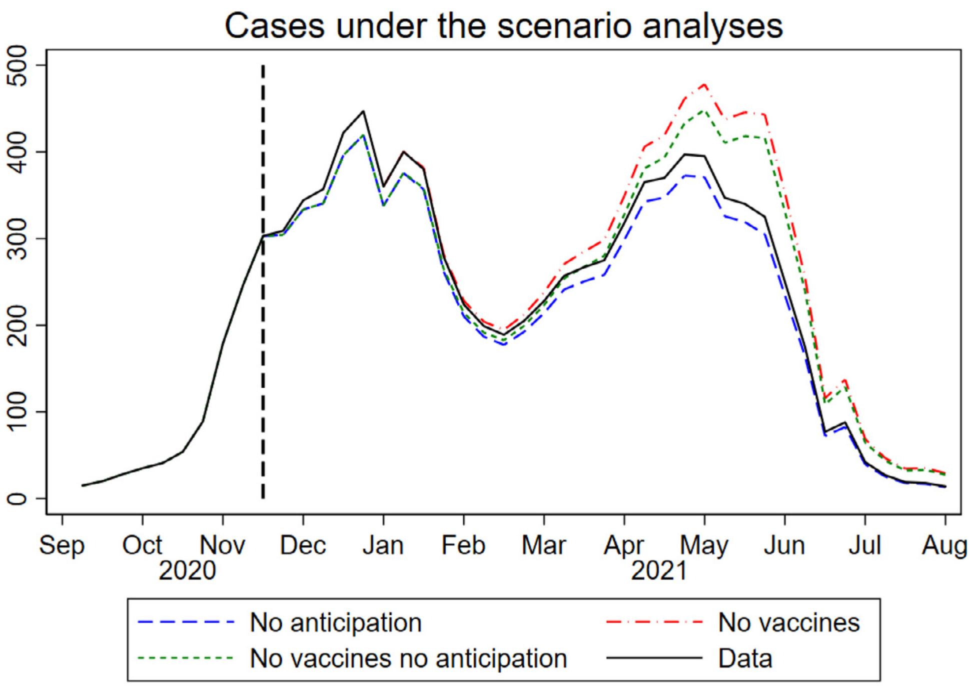
Fig. 2. Vaccine information and expectations. The figure shows the raw distribution of expectations about when life will start going back to normal across treatment groups. The light gray bars show the density for people who do not receive vaccine information before the question about the duration of the pandemic, whereas the light blue bars show the density for people who receive information before the question about the duration of the pandemic. People respond to the following statement: "In February 2021 life will start to look like it did in February 2020, before the outbreak of the pandemic." To which they could answer on a 7-point scale from "Strongly disagree" to "Strongly agree". Regression results confirm the visual impression: The treatment increases optimism about an early end of the pandemic by 0.15 of a standard deviation ($p<0.05$) (Table S8). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

We then compare the scenario of no anticipation effect with a hypothetical scenario of no vaccinations. We assume that vaccines protect individuals at the rates estimated by Pritchard et al. (2021) (for details, see Supplementary Materials, Section 3). The red dot-dashed lines in Fig. 3 represents the scenario assuming no vaccination roll-out. Since Sweden started its vaccination roll-out in late December, the benefits of the vaccines are not visible until mid-January. Overall, the cumulative number of cases in this scenario is 10,760. Finally, the green short-dashed lines in Fig. 3 displays a scenario that combines both no vaccines and no anticipation of vaccines. We construct this scenario by using the "No vaccines" scenario and applying the same methodology described to construct the scenario without vaccine anticipation. This scenario thus attempts to simulate the case in which there would have been no vaccines nor news about vaccines at all. In this situation, the cumulative number of cases is 10,191.

In sum, while the cumulative number of cases per 100,000 inhabitants in Sweden between September 2020 and July 2021 is 9,719, our simple scenario analysis implies a counterfactual 9,214 cases had there not been any anticipation effect. Compared to the 10,760 cases that we estimate would have occurred without vaccines, our estimates imply that the anticipation effect may have offset almost half of the vaccine-related reductions in cases in Sweden up until July 2021. Due to the still many unknowns of the pandemic, we acknowledge that our scenario analysis relies on many assumptions and uncertainties. Yet, we hope that they illustrate how vaccine anticipation could lead to decreased social distancing and subsequently more COVID-19 cases, potentially offsetting part of the direct benefits of the vaccines.

5. Conclusion

As a consequence of the successful COVID-19 vaccine development, encouraging news about the availability and the effectiveness of the vaccines fill the headlines around the globe. Here, we show that such good news can shift pandemic beliefs, leading to a reduction in social distancing and a lower willingness to stay at home. The likely reason is optimism: The participants that we inform about vaccines think that the duration of the pandemic will be shorter. The results are at odds with the behavior that would be expected from forward-looking individuals (Eichenbaum et al., 2021; Makris and Toxvaerd, 2020). The evidence shows that people behave less rather than more carefully when they expect a vaccine to become available. Our results, therefore, establish a novel



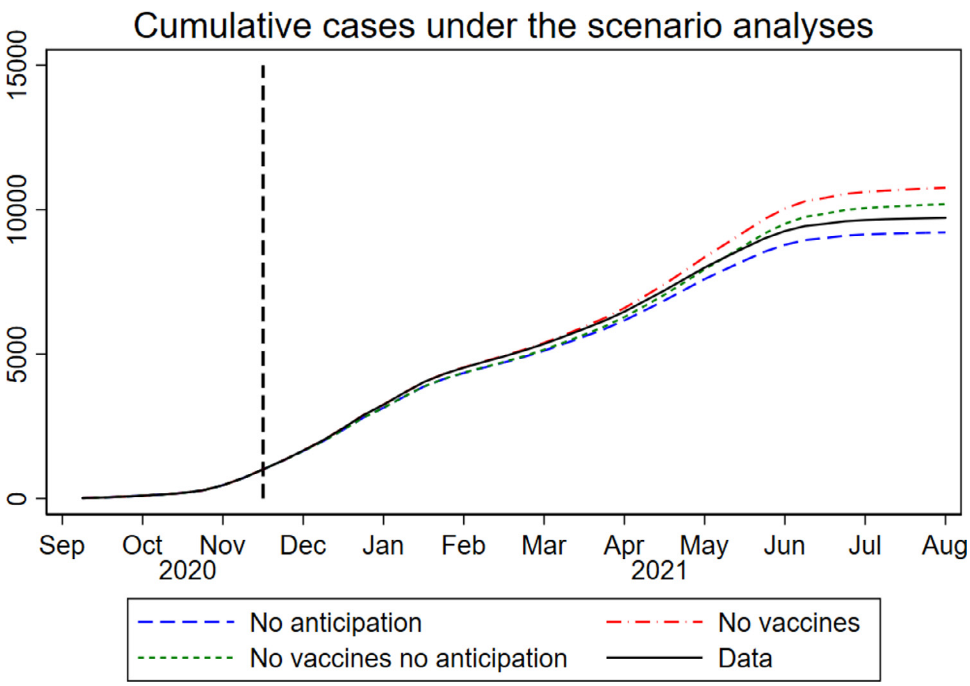


Fig. 3. Scenario analysis of the effects of vaccine anticipation on COVID-19 cases in Sweden. The solid black line in the first panel represents the number of COVID-19 cases per 100,000 inhabitants in Sweden from September 2020 to July 2021. The vertical dashed line represents the week where the positive news about the safety and effectiveness of the Pfizer and Moderna trials filled the headlines. The blue dashed line represents the simulated analysis of the cases in the absence of such positive news. The red dot-dashed line represents the simulated analysis in the absence of vaccines. The green short-dashed line represents the simulated analysis in the absence of both the anticipation effect and the vaccines. The second panel represents the same data in cumulative cases per 100,000 inhabitants. For details and sensitivity analyses, see Supplementary Materials, Section 3. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

striking behavioral phenomenon, a vaccine anticipation effect: The anticipation of a vaccine induces less careful pandemic behavior, likely translating to a substantial increase in cases.

What is the underlying reason for such a vaccine anticipation effect? It seems likely that our treatment shifts multiple factors: information about effectiveness and rollout of vaccines, trust in vaccines, feelings about the pandemic, and beliefs about when the pandemic ends. The treatment shifts beliefs about vaccines such that people become less careful. A particularly plausible explanation for people becoming less careful is that good news lead to good mood. Indeed, most news related to COVID-19 are bad news (Sacerdote et al., 2020), so good news can provide a sharp contrast and induce optimism. Consistent with what we find, such optimism could lead to lower worries (Connor and Norman, 2005; Helweg-Larsen and Shepperd, 2001), lower risk perceptions, and less careful behavior (Cohn et al., 2015; Haushofer and Fehr, 2014; Lerner et al., 2015; Meier, 2019; Meier 2021). Another plausible explanation is that information about the potential end of the pandemic makes the normal (and desired) every-day life more salient. As has been shown in other contexts (Mischel et al., 1989), such saliency could make people more impatient, worsening their intended social distancing behavior.

The academic implications of our findings are closely tied to their policy implications. Models of disease spread that are used for evaluating policy scenarios may be enriched by incorporating the degree of vaccine optimism in the population. Such incorporation may inform policy along two dimensions: First, governments need to be careful regarding the extent and tone of vaccine information, as it likely affects social distancing behavior. Second, considering vaccine anticipation has implications for policy interventions. Many governments around the world have closed down public life at the peaks of the outbreak with different restrictions. The restrictions are likely to be the most successful in preventing the spread of the disease, but their effectiveness and their economic costs hinge on the compliance of citizens (Eichenbaum et al., 2021; Farboodi et al., 2021; Garibaldi et al., 2020). Our results indicate that the effectiveness of any given policy may be lower when people anticipate a vaccine. As vaccination programs roll out, our results highlight that existing policies may be less effective in stopping the spread of the virus and stricter policies may be required.

Author contributions

OA, PCM, AM and EW contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jhealeco.2021.102530.

References

Ajzenman, N., Cavalcanti, T., Da Mata, D., 2020. More Than Words: leaders' Speech and Risky Behavior during a Pandemic. SSRN Electron. J. doi:10.2139/ssrn.3582908.

Akesson, J., Ashworth-Hayes, S., Hahn, R., Metcalfe, R.D., Rasooly I., 2020. Fatalism, Beliefs, and Behaviors During the COVID-19 Pandemic. NBER Work. Pap. 27245. https://doi.org/10.3386/w27245

Andersson, O., Campos-Mercade, P., Carlsson, F., Schneider, F., Wengström, E., 2021. The Individual Welfare Costs of Stay-At-Home Policies. forthcoming Scand. J. Econ..

Armona, L., Fuster, A., Zafar, B., 2019. Home price expectations and behaviour: evidence from a randomized information experiment. Rev. Econ. Stud. 86, 1371–1410. doi:10.1093/restud/rdy038.

Bartscher, K.B., Seitz, S., Siegloch, S., Slotwinski, M., Wehrhöfer, N..

Bavel, J.J.Van, Baicker, K., Boggio, P.S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M.J., Crum, A.J., Douglas, K.M., Druckman, J.N., Drury, J., Dube, O., Ellemers, N., Finkel, E.J., Fowler, J.H., Gelfand, M., Han, S., Haslam, S.A., Jetten, J., Kitayama, S., Mobbs, D., Napper, L.E., Packer, D.J., Pennycook, G., Peters, E., Petty, R.E., Rand, D.G., Reicher, S.D., Schnall, S., Shariff, A., Skitka, L.J., Smith, S.S., Sunstein, C.R., Tabri, N., Tucker, J.A., Linden, S.van der, Lange, P.van, Weeden, K.A., Wohl, M.J.A., Zaki, J., Zion, S.R., Willer, R., 2020. Using social and behavioural science to support COVID-19 pandemic response. Nat. Hum. Behav. 4, 460–471. doi:10.1038/s41562-020-0884-z.

Betsch, C., 2020. How behavioural science data helps mitigate the COVID-19 crisis. Nat. Hum. Behav. 4, 438. doi:10.1038/s41562-020-0866-1.

Betsch, C., Böhm, R., Korn, L., Holtmann, C., 2017. On the benefits of explaining herd immunity in vaccine advocacy. Nat. Hum. Behav. 1, 1–6. doi:10.1038/s41562-017-0056.

Betsch, C., Korn, L., Sprengholz, P., Felgendreff, L., Eitze, S., Schmid, P., Böhm, R., 2020. Social and behavioral consequences of mask policies during the COVID-19 pandemic. PNAS 117, 21851–21853. doi:10.1073/pnas.2011674117.

Betsch, C., Renkewitz, F., Betsch, T., Ulshöfer, C., 2010. The influence of vaccine-critical websites on perceiving vaccination risks. J. Health Psychol. 15, 446–455. doi:10.1177/1359105309353647.

Brewer, N.T., Chapman, G.B., Rothman, A.J., Leask, J., Kempe, A., 2017. Increasing Vaccination: putting Psychological Science Into Action. Psychol. Sci. Public Interes. 18, 149–207. doi:10.1177/1529100618760521.

Briscese, G., Lacetera, N., Macis, M., Tonin, M., 2020. Expectations, reference points, and compliance with COVID-19 social distancing measures. NBER Work. Pap. 26916. https://doi.org/10.3386/w26916

Bursztyn, L., Rao, A., Roth, C., Yanagizawa-Drott, D., 2020. Misinformation During a Pandemic. NBER Work. Pap. 27417. https://doi.org/10.3386/w27417

Campos-Mercade, P., Meier, A.N., Schneider, F.H., Wengström, E., 2021. Prosociality predicts health behaviors during the COVID-19 pandemic. J. Public Econ. 195, 104367. doi:10.1016/j.jpubeco.2021.104367.

Cappelen, A.W., Falch, R., Sørensen, E.Ø., Tungodden, B., 2021. Solidarity and Fairness in Times of Crisis. J. Econ. Behav. Organ. 186, 1–11. doi:10.1016/j.jebo.2021.03.017.

Charoenwong, B., Kwan, A., Pursiainen, V., 2020. Social connections with COVID-19-affected areas increase compliance with mobility restrictions. Sci. Adv. 6, 3054–3072. doi:10.1126/sciadv.abc3054.

Clinton, J., Cohen, J., Lapinski, J., Trussler, M., 2021. Partisan pandemic: how partisanship and public health concerns affect individuals' social mobility during COVID-19. Sci. Adv. 7, eabd7204. doi:10.1126/sciadv.abd7204.

Cohn, A., Engelmann, J., Fehr, E., Maréchal, M.A., 2015. Evidence for countercyclical risk aversion: an experiment with financial professionals. Am. Econ. Rev. 105, 860–885. doi:10.1257/aer.20131314.

Connor, M., Norman, P., 2005. Predicting Health Behaviour. McGraw-Hill Education, (UK).

de Figueiredo, A., Simas, C., Karafillakis, E., Paterson, P., Larson, H.J., 2020. Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: a large-scale retrospective temporal modelling study. Lancet 396, 898–908. doi:10.1016/S0140-6736(20)31558-0.
de Quidt, J., Haushofer, J., Roth, C., 2018. Measuring and bounding experimenter demand. Am. Econ. Rev. 108 (11), 3266–3302. doi:10.1257/aer.20171330.
Eichenbaum, M., Rebelo, S., Trabandt, M., 2021. The Macroeconomics of Epidemics. forthcoming. Rev. Financ. Stud. doi:10.1093/rfs/hhab040.
Farboodi, M., Jarosch, G., Shimer, R., 2021. Internal and External Effects of Social Distancing in a Pandemic. forthcoming. J. Econ. Theory. doi:10.1016/j.jet.2021.105293.
Fetzer, T., Hensel, L., Hermle, J., Roth, C., 2020. Coronavirus Perceptions and Economic Anxiety. Rev. Econ. Stat. 1–36. doi:10.1162/rest_a_00946.
Gaebler, C., Nussenzweig, M.C., 2020. All eyes on a hurdle race for a SARS-CoV-2 vaccine. Nature 586, 501–502. doi:10.1038/d41586-020-02926-w.
Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., Foucault, M., 2020. Gender differences in COVID-19 attitudes and behavior: panel evidence from eight countries. PNAS 117, 27285–27291. doi:10.1073/pnas.2012520117.
Galizzi, M.M., Wiesen, D., Galizzi, M.M., Wiesen, D., 2018. Behavioral Experiments in Health Economics. Oxford Research Encyclopedia of Economics and Finance. Oxford University Press doi:10.1093/acrefore/9780190625979.013.244.
Garibaldi, P., Moen, E.R., Pissarides, C.A., 2020. Modelling contacts and transitions in the SIR epidemics model. Covid Econ 5, 1–21. https://cepr.org/content/covid-economics-vetted-and-real-time-papers-0.
Gollwitzer, A., Martel, C., Brady, W.J., Pärnamets, P., Freedman, I.G., Knowles, E.D., Van Bavel, J.J., 2020. Partisan differences in physical distancing are linked to health outcomes during the COVID-19 pandemic. Nat. Hum. Behav. 4, 1186–1197. doi:10.1038/s41562-020-00977-7.
Haaland, I., Roth, C., 2020. Labor market concerns and support for immigration. J. Public Econ. 191, 104256. doi:10.1016/j.jpubeco.2020.104256.
Haaland, I., Roth, C., Wohlfart, J., 2021. Designing Information Provision Experiments. J. Econ. Lit..
Harris, K.M., Maurer, J., Kellermann, A.L., 2010. Influenza Vaccine — Safe, Effective, and Mistrusted. N. Engl. J. Med. 363, 2183–2185. doi:10.1056/nejmp1012333.
Haushofer, J., Fehr, E., 2014. On the psychology of poverty. Science 344, 862–867. doi:10.1126/science.1232491.
Helweg-Larsen, M., Shepperd, J.A., 2001. Do Moderators of the Optimistic Bias Affect Personal or Target Risk Estimates? A Review of the Literature. Personal. Soc. Psychol. Rev. 5, 74–95. doi:10.1207/S15327957PSPR0501_5.
Korn, L., Böhm, R., Meier, N.W., Betsch, C., 2020. Vaccination as a social contract. PNAS 117, 14890–14899. doi:10.1073/pnas.1919666117.
Krammer, F., 2020. SARS-CoV-2 vaccines in development. Nature 586, 516–527. doi:10.1038/s41586-020-2798-3.
Lau, K., Miraldo, M., Galizzi, M.M., Hauck, K., 2019. Social norms and free-riding in influenza vaccine decisions in the UK: an online experiment. Lancet 394, S65. doi:10.1016/s0140-6736(19)32862-4.
Lerner, J.S., Li, Y., Valdesolo, P., Kassam, K.S., 2015. Emotion and Decision Making. Annu. Rev. Psychol. 66, 799–823. doi:10.1146/annurev-psych-010213-115043.
Makris, M., Toxvaerd, F., 2020. Great Expectations: social Distancing in Anticipation of Pharmaceutical Innovations. COVID Econ 56. https://cepr.org/content/covid-economics-vetted-and-real-time-papers-0.
Marreiros, H., Tonin, M., Vlassopoulos, M., Schraefel, M.C., 2017. Now that you mention it": a survey experiment on information, inattention and online privacy. J. Econ. Behav. Organ. 140, 1–17. doi:10.1016/j.jebo.2017.03.024.
Maurer, J., Harris, K.M., Lurie, N., 2009. Reducing missed opportunities to vaccinate adults against influenza: what is realistic? Arch. Intern. Med. 169, 1633–1638. doi:10.1001/archinternmed.2009.287.
Meier, A.N., 2019. Emotions, Risk Attitudes, and Patience. SOEPpapers 1041/2019. https://www.diw.de/documents/publikationen/73/diw_01.c.669343.de/diw_sp1041.pdf
Meier, A.N., 2021. Emotions and Risk Attitudes. 2021. Forhcoming in. Am. Econ. J.: Appl. Econ.. https://www.aeaweb.org/articles?id=10.1257/app.20200164&&from=f.
Milkman, K.L., Beshears, J., Choi, J.J., Laibson, D., Madrian, B.C., 2011. Using implementation intentions prompts to enhance influenza vaccination rates. PNAS 108, 10415–10420. doi:10.1073/pnas.1103170108.
Mischel, W., Shoda, Y., Rodriguez, M.L., 1989. Delay of gratification in children. Science 244, 933–938. doi:10.1126/science.2658056.
Müller, S., Rau, H.A., 2021. Economic preferences and compliance in the social stress test of the COVID-19 crisis. J. Public Econ. 194, 104322. doi:10.1016/j.jpubeco.2020.104322.
Pritchard, E., Matthews, P.C., Stoesser, N., Eyre, D.W., Gethings, O., Vihta, K.D., …, Pouwels, K.B., 2021. Impact of vaccination on new SARS-CoV-2 infections in the United Kingdom. Nat. Med. 27, 1370–1378. doi:10.1038/s41591-021-01410-w.
Roth, C., Wohlfart, J., 2020. How do expectations about the Macroeconomy affect personal expectations and Behavior? Rev. Econ. Stat. 102, 731–748. doi:10.1162/rest_a_00867.
Rosenthal, Robert, 1966. Experimenter Effects in Behavioral Research. Appleton-Century-Crofts.
Sacerdote, B., Sehgal, R., Cook, M., 2020. Why Is All COVID-19 News Bad News? NBER Work. Pap. 28110. https://doi.org/10.3386/w28110
Schilbach, F., 2019. Alcohol and self-control: a field experiment in India. Am. Econ. Rev. 109, 1290–1322. doi:10.1257/aer.20170458.
Simonov, A., Sacher, S.K., Dubé, J.-P.H., Biswas, S., 2020. The Persuasive Effect of Fox News: non-Compliance with Social Distancing During the Covid-19 Pandemic. NBER Work. Pap. 27237. https://doi.org/10.3386/w27237
Thunström, L., Ashworth, M., Shogren, J.F., Newbold, S., Finoff, D., 2020. Testing for COVID-19: willful ignorance or selfless behavior? Behav. Public Policy 1–18. doi:10.1017/bpp.2020.15.
Zhou, Y., Xu, R., Hu, D., Yue, Y., Li, Q., Xia, J., 2020. Effects of human mobility restrictions on the spread of COVID-19 in Shenzhen, China: a modelling study using mobile phone data. Lancet Digit. Health 2 (8), e417–e424. doi:10.1016/S2589-7500(20)30165-5.
Zizzo, Daniel John, 2010. Experimenter demand effects in economic experiments. Exp. Econ. 13 (1), 75–98. doi:10.1007/s10683-009-9230-z.