Nudging for lockdown: behavioural insights from an online experiment

Thierry Blayac[#], Dimitri Dubois[#], Sébastien Duchêne[#], Phu Nguyen-Van[&], Ismael Rafaï[#], Bruno Ventelou*, Marc Willinger[#]

Montpellier, CNRS, INRAE, Institut Agro, Montpellier, France
& BETA, CNRS, Université de Strasbourg, Strasbourg, France & TIMAS, Thang Long University, Hanoi, Vietnam
* Aix Marseille Univ, CNRS, AMSE, Marseille, France & Observatoire Régional de la Santé PACA

Abstract

We study the behavioural determinants of individuals' lockdown compliance during the Covid-19 epidemic under a social-norm nudge. Following a RCT design, respondents were randomly assigned to a favourable (unfavourable) informational feedback from the Web-Application Covimoov providing daily road traffic mobility patterns - as an index of peers' compliance with the lockdown device. To do the study, we performed a web-based survey and incentivized experimental tasks, in April/May 2020, among a representative sample of the French population. The main outcome variable was the intention of lockdown compliance in case of a rebound in the Covid-19 epidemic. Incentivized tasks were used to elicit risk and time preferences, cooperative/anti-cooperative personality (free-riders), trustfulness and pro-sociability. We also collected stated preferences. The effectiveness of the nudge is challenged for the overall sample and for selected subpopulations. The various behavioural economic metrics potentially explanatory of behaviours are put in competition in order to identify the one(s) that are most strongly correlated with a positive outcome for the nudge policy. Our positive feedback was efficient only when the recipient of the nudge and the population of reference shared the same geographical location. Exploratory results also suggest that the effectiveness of the nudge is driven by free-riders who were the only ones to react to the positive feedback on peers.

Introduction

In the fight against the COVID-19 pandemic, numerous governments have made the choice to lockdown their populations (Ferraresi et al., 2020a). By limiting citizens' freedom of movement and assembly, lockdowns reduce physical contacts and appear as an efficient way to slow down the spread of the disease (Bonardi et al., 2020; Ferraresi et al., 2020b). However, this strategy is efficient if and only if it is respected and accepted by the population. Indeed, if (some part of) the population does not comply with the lockdown, enforcing it is costlier for the governments and raises important democratic questions (Bargain and Aminjonov 2020; Amat et al. 2020). Therefore, it is of utmost importance for policy makers to understand the determinants of lockdown compliance and to design policies to enhance it.

Many factors have already been investigated as predictors of compliance to anti-COVID-19 restrictions. Of course, lockdown characteristics, in terms of duration, flexibility or intensity (Gollwitwer et al., 2020) can play a role. However individual characteristics such as age or gender education, political orientation, welfare and trust in science and medicine (e.g. Kushner Gadarian et al., 2020; Nivette et al., 2020; Bertin et al., 2020; Sailer et al., 2020; Painter et al., 2020; Plohl et al., 2020; Wright et al., 2020), personality traits such as empathy, impulsivity, amorality, egoism, or psychopathy (Zettler et al.,

2020; Kuiper et al., 2020; Zajenowski et al., 2020) are all factors that can be suspected to play a role in lockdown compliance. This article provides behavioural insights in the understanding of lockdown compliance, by investigating the role of "individuals' preferences" and by testing experimentally a behavioural policy (nudge) to enhance lockdown compliance.

As economists, we suspected risk, time and social preferences to play a role in lockdown compliance. Exposure to the COVID-19 threat can be viewed as an unfavourable "background risk". Such type of risk has a tempering effect on risk averse individuals, who become more risk averse if exposed to an independent background risk, a behavioural pattern known as "risk-vulnerability" (see Gollier and Pratt, 1996 for the theoretical foundation and Beaud and Willinger, 2015 for experimental support). More risk averse individuals are therefore more likely to comply in order to reduce their exposure to adverse events. The impact of background risk on time preferences is less clear. Intuition suggests that more patient individuals are more compliant because they have higher discount rates: their immediate cost of compliance looms larger than their discounted benefits from lockdown. However, several papers found a negative correlation between risk tolerance and impatience: more risk tolerant individuals are also more patient (Dohmen et al., 2010, Clot et al., 2017, Dean and Ortoleva, 2019). If individuals who are exposed to the COVID-19 background risk become more risk averse, do they also become more impatient? In a student subjects pool (N = 185), Müller and Rau (2020) found that more patient and more risk averse individuals express higher compliance in the COVID-19 context.

We also expected that pro-social individuals, in a broad sense, would be more likely to comply in an attempt to prevent others from the risk of infection. Lockdown compliance is costly for the individual, as it reduces his/her freedom of movement, but is beneficial for self and others, by reducing viral exposure and thereby the likelihood of infection. In short, there is a clear trade-off between a health social benefit and some individual costs. Testing whether psychological traits have an impact on this kind of trade-offs has already been studied for specific health decisions, like vaccines, also showing a dilemma between social benefit and individual costs (Massin et al. 2015; Collange et al., 2016). In particular, in the public health domain, several papers have discussed the insights from behavioural economics to promote vaccine uptake (e.g. Betch and al. 2015, Chen and Stevens, 2017), emphasizing the potential for nudge policies to increase vaccination rates in the population. One paper (Korn et al., 2018) especially relies on the mechanism of the social dilemma, where individuals' interests may conflict with group interests, as we will do in the present paper. It proposed to implement a social-comparison nudge, using feedback information to influence individuals' vaccination uptake; the authors did not find confirmatory results at the "conventional criteria of statistical significance" (as said), suggesting further research.

In this paper, we address the issue of the mediating role of respondents' preferences in channelling feedback information aiming at encouraging compliance. To what extent does public information about others' behaviour encourage/discourage adoption of the same desirable behaviour? This question is important because lockdown compliance has important positive externalities: each individual benefits from others' compliance, and his or her own compliance benefits others. Providing public information about peers' compliance is therefore likely to affect her own compliance. We hypothesized that a suitable information feedback provided to the respondents about the behaviour of their peers, could strongly influence individuals' lockdown compliance attitude. Disseminating information about prevalent behaviour tends to lead people to copy them. Such behaviour is supported by theories of preference for conformity in psychology (e.g. Ash, 1951, 1956) and in economics (Akerlof, 1980, Bernheim, 1994) and by theories of interdependent preferences, such as psychological game theory. In the sequel we shall refer to policy interventions that rely on such type of feedback, pushing individuals

to a social comparison, as "social nudges". Social nudges have been successfully implemented in energy consumption (Allcott, 2011; Allcott and Rogers, 2014; Costa and Kahn, 2013), contributions to public goods (Chen et al., 2010) or traffic violations (Chen et al., 2017). At a time where very few behavioural studies were available (March 2020), the latter studies represented a source of inspiration for our nudging strategy.

We contribute to the literature on anti-COVID-19 policy design, by focusing on the behavioural determinants of lockdown compliance in a representative sample of the French population. We do this by i) testing a "social influence" nudge, and ii) investigating the role of behavioural determinants as channels that could affect the effectiveness of such a type of nudge for lockdown compliance. We add two new features to the existing literature: first, while mobilizing a representative sample of the population, we elicited individuals' preferences based on incentivized and validated experimental tasks, in an on-line lab-in-the-field setting as well as self-reported measures; second, we implemented a Random Controlled Trial (RCT), on this same representative sample, to test the effectiveness of a social-influence nudge on lockdown compliance intentions. We are thus part of a general tendency to search for external validity of experimental economics, by pushing open the doors of the laboratory to investigate in the field.

To give a little more detail on the current paper: we elicited individual and social preferences both with incentivized experiments and stated preferences. We relied on incentivized experiments for eliciting pro-sociability based on Social Value Orientation (SVO, Murphy et al. 2011), cooperativeness as measured by the level of contribution under the voluntary contribution mechanism (VCM), risk preference elicited with the portfolio choice task (Gneezy and Potters, 1997) and time preferences using the CTB method (Andreoni and Sprenger, 2012). We also relied on Dohmen et al. (2011) to measure risk attitudes, time preference (Falk et al. 2018), trustfulness, and mindfulness (Brown and Ryan, 2003; Carlons and Brown, 2005).

Our results suggest a weak explanatory power of experimentally elicited preferences, in contrast to self-reported measures of preferences. Our social nudge was effective only when the recipient of the nudge shared the same geographical region than the reference population. Moreover, our results suggest that the behaviour exhibited in the Public Good Game was a moderator of this effectiveness: social influence is especially nudging free-riders, pushing them towards more acceptance of future lockdown compliance.

1. Description of the study

In subsection 1, we start with a short description of our data base. Subsection 2 provides a detailed description of our social-norm nudge. Subsection 3 introduces the dependent variable that was targeted by the social-norm nudge. Finally, in subsection 4 we present the explanatory variables that were considered as channels potentially activated by the social-norm nudge.

1.1 Design of the survey: sample and representativeness

We managed a web-based lab-in-the field collection of data among a representative sample of the French population – see appendix figure A1 for data on representativeness. Beginning at the end of

March 2020, the survey institute *Viavoice*[1] recruited respondents by telephone for the online questionnaire. Over the 7500 persons that were contacted by telephone, 5331 accepted and received a web link, 1154 responded to the online survey, with a fully completed questionnaire and a signed online informed consent form (response rate 21.6%). The web-based survey, developed with the oTree platform, was available for 2 weeks, from 4th May 2020 to 16th May 2020, on a dedicated server managed by the research-team.

1.2 A randomized controlled trial nested in the study: a social-norm nudge aiming at increasing adherence to lockdown

The idea of our social nudge, which relies on the principle of social comparisons with *alter egos*, was inspired by nudges that are often applied in the domain of energy consumption[2]. The principle is to influence individuals by providing them a favourable social pattern to compare to. In the case of energy consumption, people receive feedback on energy use by their "neighbours", that intends to push them to energy conservation. Transposed in the field of lockdown compliance, this principle consists in informing respondents about lockdown compliance by their proximate counterparts.

The practical implementation of the social nudge took advantage of the information and similar verbatim as the one released on the 24/7 news channel (e.g. BFMTV, see Figure 2).

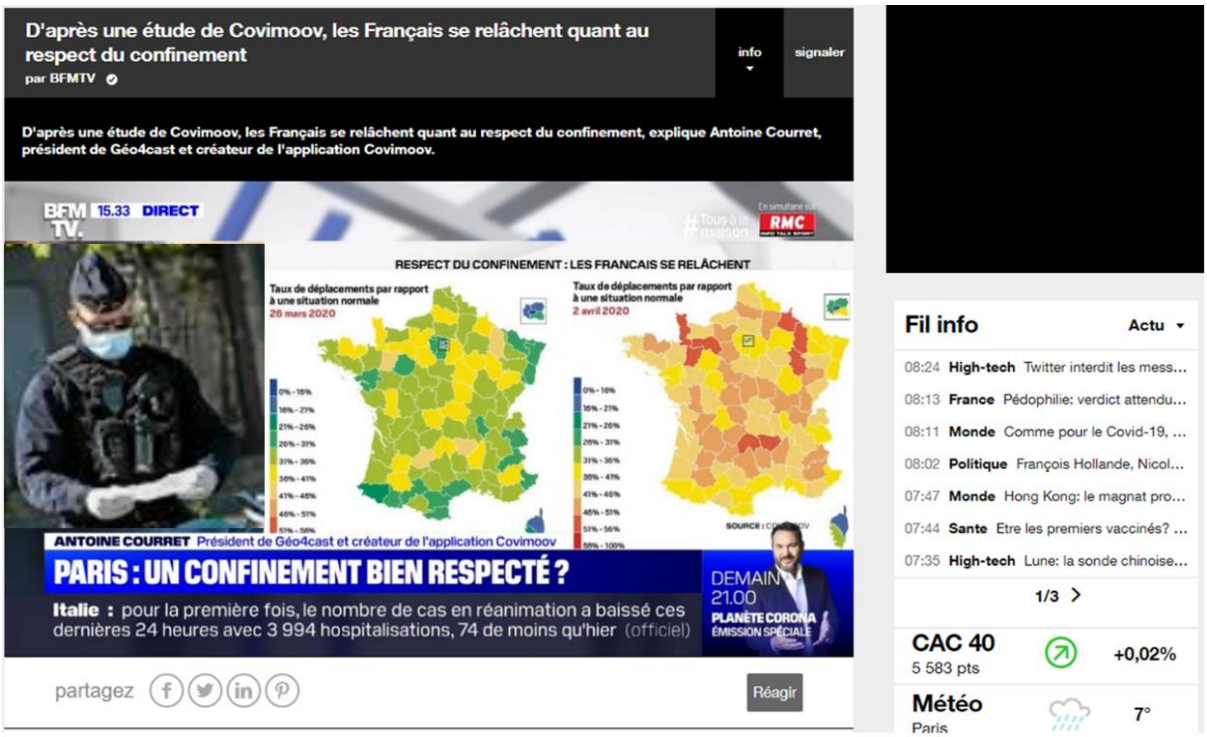

Figure 2: Screenshot of the 24/7 news channel BFMTV during the lockdown

We accessed to the Web-Application *Covimoov* (Covimoov - GEO4CAST) providing road-traffic patterns information, from which we extracted the information for two dates: 3rd of April (positive

[1] http://www.institut-viavoice.com/

[2] Research on social comparison about energy consumption include Kantola, Syme, and Campbell (1984); Allcott (2011, 2015); Ayres, Raseman, and Shih (2013); Costa and Kahn (2013); Dolan and Metcalfe (2013); Allcott and Rogers (2014); and Sudarshan (2014). Delmas, Fischlein, and Asensio (2013) reviews 156 published field trials studying social comparisons and other informational interventions to induce energy conservation. We especially relied on Costa and Kahn. (2013).

treatment, nudge +) and 17th of April (negative treatment, nudge -), about road traffic in the Normandy Region (see Figure 2). As we were seeking to communicate using the largest contrast possible between the two feedbacks (positive vs negative), the Normandy region was selected because it was the region exhibiting the highest difference between two proximate dates just before the survey, from all regional data available in the 'Coovimoov app'.

Figure 2: Map of the French administrative regions and departments

We informed the respondents as follows (screenshot available in the appendix):

"The application Covimoov identifies motorist trips in the regions, and compares them to a normal pre-crisis period."

Then we randomized our 1154 respondent into two groups (G1 = 566; G2 = 588):

G1: message (+)

"(3rd of April info...): a greatly reduced traffic was recorded for a Friday in Normandy, with barely 40% of the flow of usual trips, demonstrating scrupulous respect for confinement."

G2: message (-)

"(17th of April info...): an almost normal traffic was recorded for a Friday in Normandy, showing a certain looseness for confinement."

This randomized treatment was followed by the question (common to both groups):

What do you think is the level of containment compliance today in your own region? Please select only one of the following: [Scrupulous respect; Respect; Looseness; Strong looseness][3]

This nudge was followed by the question (common to both groups):

In the event of a new confinement made necessary by a rebound in the epidemic, would you say that you will scrupulously respect the government instructions of containment? Place your answer on a scale of 0 to 10 - (with 10 the most scrupulous respect)[4]

The answer to this last question is our key dependent variable (noted CRR thereafter) on which we focus in the remainder of this paper.

1.3 The dependent variable

Let CRR_i denotes the anticipated degree of compliance to a future lockdown reported by the respondent i on the 0-10 scale (0 for the lowest and 10 for the highest level of compliance). The distribution of this variable, displayed in Figure 4, shows a right-skewed distribution with the mode at 10. In order to properly explain the degree of compliance, we propose several econometric specifications.

For clarity of presentation, we present in the main text the reference-one, which is a binary probit model based on the redefinition of CRR as a binary dependent variable: $CRRb$ = 1 if the anticipated level of compliance is either 9 or 10, $CRRb$ = 0 otherwise. The regression model is:

$$Pr(CRRb_i = 1|X_i) = \Phi(X_i'\beta)$$

where $\Phi(.)$ is the cumulative normal distribution and X_i is the set of explanatory variables. The latter includes behavioural measures, and also usual control variables (gender, age -see complete list below Tables). For robustness check, we also provide in Appendix Tobit regressions, where the dependent variable, corresponding to the original variable CRR, is censored between 0 and 10.

[3] Translated from French. Original text: (G1+G2) *L'application Covimoov recense les déplacements d'automobilistes en région, et les compare à une période normale d'avant-crise.* (G1 – Nudge+) *Le 3 avril, on enregistrait un trafic fortement réduit pour un vendredi en Normandie, avec à peine 40% du flux de déplacements habituels, démontrant un respect scrupuleux du confinement.* (G1+G2) *Quel est selon vous le niveau de respect du confinement aujourd'hui dans votre propre région ?*

[4] Translated from French. Original text: *Dans l'hypothèse d'un nouveau confinement rendu nécessaire par un rebond de l'épidémie, diriez-vous que vous respecterez scrupuleusement la consigne gouvernementale de confinement ? Placez votre réponse sur une échelle de 0 à 10.*

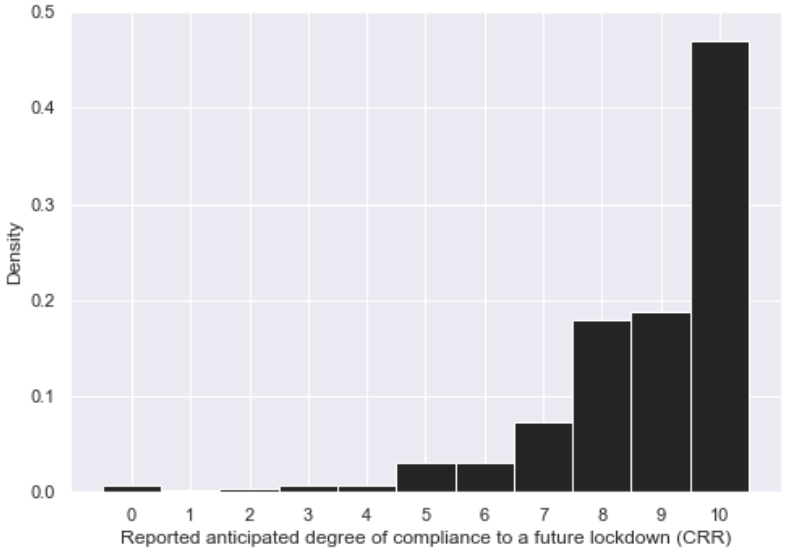

Figure 4: Distribution of anticipated degree of compliance

1.4 Behavioural explanatory variables documented in the study

Two types of behavioural measures were implemented: incentivized experimental tasks and stated preferences. In order to compare the empirical relevance of these two methodologies, we matched stated preferences and experimentally elicited preferences for two dimensions: risk preferences and time preferences. Social preferences dimensions were either measured by stated preferences (trust) or through experimental tasks (cooperativeness and pro-sociability). Each of these behavioural traits is likely to affect compliance. Table 1 below gives a summary of the tasks and Table 2 the definition of each variable.

Assuming that the COVID-19 infection threat can be interpreted as an unfavorable background risk (Gollier and Pratt, 1996), the risk-vulnerability hypothesis predicts that more risk averse individuals are more likely to comply with lockdown. However, the interplay between background risk and time preferences is an open question. More impatient individuals might be less likely to be compliant because they have higher discount rates: their immediate cost of compliance looms larger than their discounted benefits from lockdown. However, according to several empirical papers (Dohmen et al., 2010, Clot et al., 2017, Dean and Ortoleva, 2019) more impatient individuals are also more risk averse, which would lead them to be actually more compliant.

We hypothesized that higher cooperativeness, trustfulness and pro-sociability would positively affect compliance. Individuals who contribute more to the common account in the lab might also be more cooperative with respect to the common good in the wild. Similarly, more prosocial individuals are expected to be more inclined to avoid harm to others (Galizzi and Navarro-Martinez, 2019). We suspected truthfulness to have an ambiguous effect on compliance. People who trust more in others might hold false beliefs about others' trustworthiness. For example, they might believe that their peers strongly respect barrier gestures, which could lead them to adopt a lax attitude towards lockdown. On the other hand, trust might be targeted towards believing that others adopt a compliant attitude, which would lead the trustful to imitate the expected norm of compliance.

Type of tools / Dimension	Self-reported questions	Incentivized tasks
Risk attitudes	Willingness to take risk general / health / money (Dohmen et al., 2011)	Task 1: Portfolio choice task (Gneezy and Potter, 1997)
Trust / Cooperativeness	Global Society Survey[5] (GSS)	Task 2: Voluntary contribution to a (linear) public good - PGG
Pro-sociability		Task 3: SVO (Murphy et al., 2011)
Time preferences	Self reported 0-10 scale	Task 4: Convex Time Budget method (Andreoni and Sprenger, 2012)
Mindfulness, quality of consciousness[6]	Mindful Attention Awareness Scale (Brown and Ryan, 2003)	

Table 1: Stated preferences questions and experimental tasks

Incentivized elicitations were composed of 4 different tasks. Participants were informed that only one of the four tasks will be randomly selected for final payment. All participants play the tasks in the same order. The first task consisted in a Portfolio choice task a la Gneezy and Potter (1997). The second task consisted in a linear four players public good game. The third task consisted in the 6-item Social Value Orientation (SVO) as in Murphy et al. (2011). The fourth task consisted in a convex time budget method a la Andreoni and Sprenger (2012), where participants has to make two different allocation decisions between two different dates (for this task, only one of the two decisions can be selected for payment). Table 2 gives a summary of respondent's performances in each task.

[5] We used the standard GSS question "*Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?*" both with a dichotomous response mode and an 11-scale response mode. As the variable GSS captures how the respondent is "able to make a bet on the other's behaviour" (as a measure of trust), this could be related to the Public Good Game (PGG). This presentation (for ease) in the Table1 has no impact on the analysis.

[6] The Mindful Attention Awareness Scale (MAAS) allows to assess an individual's level of mindful state. The MASS is made up of 15 statements about everyday experiences that can be lived for each individual more or less frequently. The participant is asked to answer on a 6-point Likert scale, for the degree of frequency she may have had for each of the 15 experiences. The higher the score, the more mindful the participants are.

Variable name	Definition	Mean	Standard deviation
Risk_aversion	Amount of money invested in the Portfolio choice task.	5.445	7.619
	Gains in the game	*22.17€*	*14.34€*
SVO_angle	Social Value Orientation angle as in Murphy et al. (2011).	32.012	13.290
	Gains in the game	*38.23€*	*13.96€*
PGG	Amount of money invested in the Public Good Game (PGG)	5.376	7.287
	Gains in the game	*25.37€*	*7.29€*
Discount	Share of endowment invested at the first dates of the CTB task.	0.348	0.309
	Gains in the game (first date)	*13.97€*	*13.56€*
Present_bias	Ratio between the first date investment in the first period and the first date investment in the second period of the CTB task.	2.031	5.700
	Gains in the game (second date)	*31.24€*	*16.27€*
Risk_general	Self-reported willingness to take risk in general (0-10)	3.931	2.695
Risk_financial	Self-reported willingness to take risk in financial situation (0-10)	2.653	2.529
Risk_health	Self-reported willingness to take risk in health situation (0-10)	2.335	2.529
Trust_general	Self-reported level of trust in general (0-10)	4.457	2.563
Trust_family	Self-reported level of trust toward family members (0-10)	7.586	2.756
Trust_professional	Self-reported level of trust toward colleagues (0-10)	4.639	2.807
Patience	Self-reported level of patience (0-10)	5.919	2..749
Mindfulness	Mindfulness Attention Awareness Scale as in (Brown and Ryan, 2003)	4.332	0.717

Table 2: Variables' definition and distribution.

2. Results

We first present the result on the efficiency of the social influence nudge to enhance lockdown compliance, as a function of the geographical distance between the population of reference (Normandy inhabitants) and the recipient of the nudge (inhabitant of Normandy vs neighbouring department vs France). Then we present results on the behavioural determinants (self-reported and incentivized measures of preferences) of lockdown compliance. Table 3 summarizes the results. Finally, we investigate whether those behavioural determinants are moderators of nudge efficiency.

Result 1: Social influence nudge increases future lockdown compliance only when the recipient of the nudge and the reference population shared the same geographical region.

Figure 5 presents the proportion of individuals reporting a high intention to respect the future lockdown (i.e. acceptation > 80%), as a function of the social influence nudge (negative social norm vs positive social norm) and the geographical location of the recipient of the nudge (Normandy vs Neighbouring departments vs France).

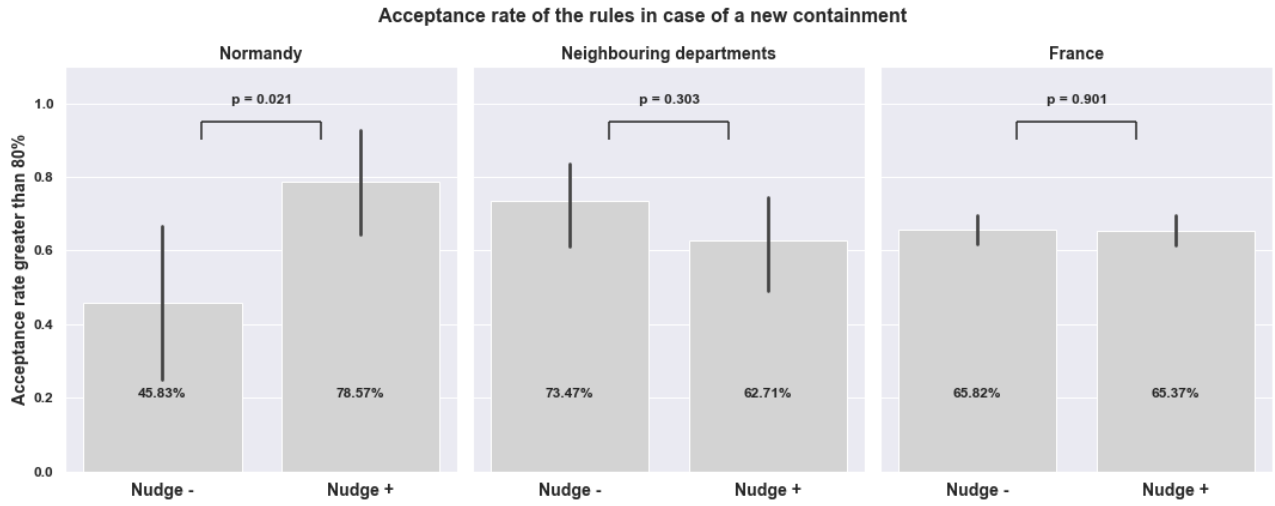

Figure 5: Compliance to a future lockdown as a function of social influence and social distance.

Positive social influence nudge increases the probability to have a higher acceptance rate of the future lockdown in Normandy (*Nudge - : M= 45.83%, Nudge+ : M=78.57%, Fisher-exact test, p=0.021*) but not for the neighbouring departments (*Nudge - : M= 73.47%, Nudge+ : M=62.71%, Fisher-exact test, p=0.303*) or for all the population (*Nudge - : M= 65.82%, Nudge+ : M=65.37%, Fisher-exact test, p=0.901*). Those results are confirmed by probit regressions (see Table 3).

Result 2: Experimentally elicited preferences do not predict future lockdown compliance.

The experimental measures of risk aversion, social preferences (social value orientation and cooperativeness) and time preferences (discount and present bias) are not good predictors of future lockdown compliance intentions. None of the associated coefficients is statistically significant (see Table 3, models 3, 4, 7, 8), and adding those variables does not increases significantly model goodness of fit [*Likelihood ratio tests: models 4 vs 2:* $\chi^2(5) = 2.872, p = 0.720$*; models 8 vs 6:* $\chi^2(5) = 4.798, p = 0.441$].

Result 3: Self-reported measures of preferences predict future lockdown compliance.

The self-reported measures of risk attitude, trust in others, patience and mindfulness are predictors of the intentions to comply to a future lockdown since adding those variables improves significantly models goodness of fit [*Likelihood ratio tests: model 6 vs 2:* $\chi^2(8) = 80.527, p < 0.001$*; model 8 vs 4:* $\chi^2(8) = 82.450, p < 0.001$].

	CRRb							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nudge								
Nudge	−0.030	−0.035	−0.027	−0.033	−0.043	−0.032	−0.046	−0.035
	(0.082)	(0.088)	(0.082)	(0.089)	(0.085)	(0.091)	(0.085)	(0.092)
Nudge×Normandy	0.926**	0.951**	0.947**	0.959**	1.140***	1.173***	1.176***	1.187***
	(0.378)	(0.388)	(0.380)	(0.389)	(0.394)	(0.405)	(0.397)	(0.409)
Nudge×Neighbouring	−0.273	−0.187	−0.275	−0.192	−0.293	−0.256	−0.303	−0.276
	(0.267)	(0.283)	(0.268)	(0.283)	(0.277)	(0.291)	(0.277)	(0.291)
Elicited Preferences								
Risk_aversion			−0.005	−0.024			0.028	0.007
			(0.056)	(0.059)			(0.058)	(0.061)
SVO_angle			0.031	0.018			0.045	0.019
			(0.038)	(0.041)			(0.040)	(0.043)
PGG			0.043	0.057			0.062	0.083
			(0.056)	(0.060)			(0.058)	(0.062)
Discount			0.054	0.058			0.047	0.051
			(0.039)	(0.042)			(0.041)	(0.044)
Present_bias			0.028	−0.006			0.035	0.002
			(0.040)	(0.041)			(0.042)	(0.043)
Stated Preferences								
Risk_general					−0.162***	−0.171***	−0.170***	−0.180***
					(0.051)	(0.056)	(0.051)	(0.057)
Risk_financial					−0.017	−0.015	−0.028	−0.025
					(0.045)	(0.050)	(0.046)	(0.050)
Risk_health					−0.178***	−0.142***	−0.173***	−0.137***
					(0.047)	(0.051)	(0.047)	(0.051)
Trust_general					−0.068	−0.057	−0.075	−0.064
					(0.052)	(0.057)	(0.053)	(0.057)
Trust_family					0.113**	0.116**	0.114**	0.121**
					(0.049)	(0.052)	(0.050)	(0.053)
Trust_professional					−0.109**	−0.113*	−0.110**	−0.115**
					(0.054)	(0.058)	(0.055)	(0.058)
Patience					0.064	0.074*	0.070*	0.079*
					(0.041)	(0.044)	(0.042)	(0.044)
Mindfulness					0.113***	0.140***	0.107**	0.136***
					(0.042)	(0.045)	(0.042)	(0.046)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Constant	8.759***	8.498***	8.755***	8.489***	8.770***	8.425***	8.770***	8.420***
	(0.077)	(0.160)	(0.077)	(0.161)	(0.073)	(0.154)	(0.073)	(0.154)
Normandy	−0.343	−0.420	−0.312	−0.393	−0.368	−0.373	−0.329	−0.338
	(0.365)	(0.362)	(0.366)	(0.363)	(0.346)	(0.346)	(0.346)	(0.347)
Neighbouring	0.139	0.032	0.153	0.044	0.154	0.036	0.173	0.052
	(0.261)	(0.267)	(0.262)	(0.268)	(0.247)	(0.255)	(0.248)	(0.256)
Observations	1,154	1,047	1,154	1,047	1,154	1,047	1,154	1,047
Log Likelihood	−738.826	−641.257	−736.972	−639.821	−687.418	−600.993	−684.216	−598.595
Akaike Inf. Crit.	1,489.653	1,316.514	1,495.944	1,323.642	1,402.837	1,251.987	1,406.432	1,257.189
McFadden Pseudo R^2	0.0053	0.0464	0.0078	0.0485	0.0745	0.1063	0.0789	0.1099
Note:								*p<0.1; **p<0.05; ***p<0.01

Table 3: Determinants of lockdown compliance. Probit regressions.

Note: All explicative variables have been normalized prior to regression, for interpretation ease. Controls include i) gender, ii) being younger than 25, iii) being older than 60, iv) household wage, being locked down v) in a house, vi) alone and vii) with child, viii) living in a region with high infection rate ("Grand Est" or "Ile de France"), ix) being a person at risk, x) living with a person at risk.

In particular, the probability to report a high intention to respect a future lockdown is higher for the participants who report higher trust in their family circle [*Table 3, model 8, Average Marginal Effect (AME) = 0.0393, p = 0.021*], for those who report lower trust in their working circle *[Table 3, model 8: AME = - 0.0373, p = 0.048*], for those who report lower willingness to take risk in general [*Table 3, model 8: AME = - 0.0585, p = 0.001*] and in the health domain [*Table 3, model 8: AME = - 0.0445, p=0.007*], and for the participants who are more mindful [*Table 3, model 8: AME = 0.0441, p=0.003*].

The self-reported level of patience has only a marginally significant positive effect on the probability to report a high intention to respect a future lockdown [*Table 3, model 8: AME = 0.0257, p=0.073*], but this effect is not robust to all model specifications. We find no significant effect for the general level of trust reported [*Table 3, model 8: AME = - 0.0208, p=0.261*] nor the reported level of risk in the financial domain [*Table 3, model 8: AME = - 0.0081, p=0.621*].

Exploratory result (4): Positively nudged free-riders foster compliance.

For the subpopulation of Normandy for which the social influence nudge was effective, we investigate the potential moderators of nudge effectiveness among elicited and self-reported preferences. Since we rely only on a small sample (N=52), we run separate probit regression analyses (one for each measure of stated and revealed preferences) and consider the obtained results as exploratory. Results for the revealed (stated) preferences are presented in Table 4 (Table 5).

	Dependent variable:				
	CRRb				
	(1)	(2)	(3)	(4)	(5)
Nudge	0.831**	1.084***	0.681	0.902**	0.827*
	(0.381)	(0.403)	(0.421)	(0.376)	(0.440)
Risk_aversion	0.428*				
	(0.256)				
Nudge×Risk_aversion	−0.705*				
	(0.369)				
SVO_angle		0.415			
		(0.305)			
Nudge×SVO_angle		−0.252			
		(0.381)			
PGG			0.781**		
			(0.395)		
Nudge×PGG			−1.233***		
			(0.465)		
Discount				0.008	
				(0.238)	
Nudge×Discount				0.184	
				(0.358)	
Present_bias					1.027
					(1.150)
Nudge×Present_bias					−0.709
					(1.344)
Constant	−0.077	−0.226	0.126	−0.107	0.012
	(0.268)	(0.284)	(0.312)	(0.264)	(0.326)
Observations	52	52	52	52	52
Log Likelihood	−29.067	−29.702	−26.855	−30.815	−29.872
Akaike Inf. Crit.	66.135	67.404	61.709	69.629	67.745
McFadden Pseudo R^2	0.148	0.130	0.213	0.097	0.125
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 4: Elicited preferences as moderators of Nudge efficiency.

Concerning revealed preferences, we find a significant interaction between the social-influence nudge and the amount of contribution in the public good game: nudging positively the participants who did not invest in these tasks have a negative impact on the level of future compliance [*Table 4, model 3*: interaction variable Nudge x PGG, p=0.008] and a marginally significant interaction between the nudge and risk aversion [*Table 4, model 1,* Nudge x Risk_aversion: *p=0.056*].

More precisely, we were not able to observe an effect of the nudge for the cooperative participants [*N=16, Fisher exact test: p=0.585*] but the nudge was effective on free-riders by increasing from 29.41% to 84.21% the estimated probability to report a high compliance to the future lockdown [*N=36, Fisher exact test: p= 0.002*].

Figure 6: Intention to comply to the lockdown as a function of Social norm nudge and cooperativeness

Concerning the stated preferences measures, we were not able to detect any significant interaction between the social influence nudge and the stated preferences [*Table 5, all interaction coefficients are not significant*].

	CRRb							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nudge	0.998**	0.897**	1.257***	0.877**	0.901**	0.784**	0.817**	1.228***
	(0.411)	(0.373)	(0.434)	(0.376)	(0.372)	(0.381)	(0.384)	(0.440)
Risk_general	−0.648**							
	(0.296)							
Nudge×Risk_general	0.223							
	(0.403)							
Risk_financial		−0.101						
		(0.248)						
Nudge×Risk_financial		0.050						
		(0.358)						
Risk_health			−0.699**					
			(0.356)					
Nudge×Risk_health			0.112					
			(0.500)					
Trust_general				−0.070				
				(0.272)				
Nudge×Trust_general				−0.184				
				(0.393)				
Trust_family					0.014			
					(0.283)			
Nudge×Trust_family					0.006			
					(0.358)			
Trust_professional						−0.302		
						(0.310)		
Nudge×Trust_professional						−0.044		
						(0.420)		
Patience							0.087	
							(0.290)	
Nudge×Patience							−0.496	
							(0.399)	
Mindfulness								0.368
								(0.377)
Nudge×Mindfulness								0.051
								(0.460)
Constant	−0.057	−0.115	−0.271	−0.091	−0.106	−0.048	−0.085	−0.151
	(0.276)	(0.258)	(0.293)	(0.262)	(0.257)	(0.265)	(0.265)	(0.264)
Observations	52	52	52	52	52	52	52	52
Log Likelihood	−27.084	−30.998	−27.250	−30.633	−31.095	−29.779	−29.948	−29.160
Akaike Inf. Crit.	62.168	69.997	62.501	69.267	70.191	67.557	67.896	66.320
McFadden Pseudo R^2	0.207	0.092	0.202	0.103	0.089	0.128	0.123	0.146
Note:								*p<0.1; **p<0.05; ***p<0.01

Table 5: Stated preferences as moderators of Nudge efficiency.

We also tested if the beliefs concerning regional peers' compliance (rated from 1 = "Scrupulous respect" to 4 = "Strong looseness"[7], see section 1.2) were a good moderator of the nudge, with a probit regression on CRRb. We find no direct effect of the beliefs on lockdown compliance *[p=0.427]* and no direct effect of the nudge on the beliefs [*p=0.607*].

3. Discussion

In their advocacy of "social and behavioural science to support COVID-19 pandemic response", Van Bavel et al. (2020) mention that nudges can be an alternative to more coercive means of behaviour change or used to complement regulatory, legal and other imposed policies when widespread changes must occur rapidly". However, relying on nudges to improve or enforce compliance is questionable.

[7] This was the question asked just after the randomized information on road traffic; see section 1.2.

Although we lack perspective, scant available evidence seems to convey a rather negative message, excepting the Indian experience (see Debnath and Bardhan, 2020). Hume et al. (2020) find that a nudge emphasizing attention to others, affects positively short-term intentions to comply, but that these good intentions fade away quickly, as shown by their follow up study. Sanders et al. (2020) failed to replicate the classical loss aversion nudge in the context of the Covid Pandemic (N = 500). In the same vein, the management of the crisis by the British government, based on nudging citizens, was severely criticized (Sibony, 2020)[8].

In this paper, we have introduced a novel type of nudge based on conveying a social-influence information about lockdown compliance, with the assumption that the social comparison could push people to modify their lockdown compliance attitudes. Specifically, two sub-samples of respondents were randomly assigned to a 1) positive *vs* 2) negative feedback about the state of the collective compliance to lockdown in Normandy, a region of France. As we were seeking to communicate using the largest contrast possible between the two feedbacks (positive vs negative), Normandy region was selected because it was the location giving the highest difference between two proximate dates just before the survey, from all regional data available in the 'Coovimoov app'. We did not anticipate that the salience of the region "Normandy" would be so "strong" in the mind of the respondents. Our main results are the following: i) only the respondent in Normandy were sensitive to the nudge; suggesting that the social-norm nudge is working when the community to which it refers is close to the population who receive the social-norm message (Normandy); ii) in Normandy, the nudge was only effective for the population who was free-riding in the public good game (PGG); iii) in general, elicited measures of risk, social, and time preferences are not good predictors of self-reported intention to comply to a future lockdown if compared to stated measures.

Although our statistical findings have to be taken with caution, in part because the second result is based on a subsample of limited size, we believe that our study is bringing some stimulating messages. Our interpretation of the main finding -nudge impacts only for Normandy- is that respondents who received the favourable message were more likely to comply as far as the social-norm nudge was proposing a close in-group comparison. According to social identity theory (Tajfel and Turner, 1979), individuals are more willing to follow their in-group members than the out-groups. Identification to a social group leads individuals to adopt behaviour that conforms to the perceived shared norm of their group (see e.g. Goette et al., 2006; Chen and Li, 2009; Drouvelis and Nosenzo, 2013). We therefore logically obtained that inhabitants from the Normandy Region were more likely to react positively than other respondents to a nudge targeting residents from the Normandy Region. However, we expected that inhabitants from the border regions and departments of the Normandy region would be, at least, weakly affected by the nudge. The absence of spillover effects is striking and surprising, as if the targeted region was waterproof. This observation seems at odds with social distance theory (Liberman et al., 2007) according to which more closely related individuals are more likely to adhere to shared norms of behaviour.

As an exploratory result, we observed that free-riders (revealed by the PGG) in the Normandy region state higher future compliance when positively nudged. Being informed about a high level of compliance by their peers in the past, makes them more compliant for the future. This finding agrees with experimental findings about leading-by-example in experimental voluntary games. These experiments showed that free-riding incentives are tempered when a leader sets the good example (Levati et al., 2007, Drouvelis and Nosenzo, 2013). An important reason is the combination of strategic

[8] Almqvist and Andersson (2020) asked respondents to rate 5 hypothetical policies, a subsidy, a fine, an information/recommendations device, a nudge and curfew. Respondents were least in favour of the nudge.

uncertainty and preference for conformity. Free riders who hold (false) beliefs about others's free-riding intentions are more likely to change their behaviour when the positive knowledge about others' cooperativeness becomes available.

Yet, the design of our study allows us to further analyse the mechanism by which the nudge works, also eliminating red herring. Indeed, one might think that information about other peers' behaviour in April 2020 causes the individual to revise their beliefs about actual peers' cooperative behaviour at the date of the survey -which was in May. This is not the case. After checking, the belief about peers' behaviour in Normandy is not a mediator of the positive nudging effect (see result 4, the latest test - however made on the 52 respondents of Normandy). The fact that the effect does not pass through a revision of beliefs about the actual behaviour of neighbours, but rather about the knowledge of a latent social practice in the region, indicated by the Covimoov patterns, suggests that the effectivity of the nudge is not a matter of a rational calculation on the return to one's effort ("my neighbors are themselves little exposed, and I can therefore benefit more from reducing my exposure myself "), as it could be suspected. It is probably more a direct reflex to imitate others and a simple desire to conform to the main social practice. This reinforces the social identification interpretation (Akerlof, 1980, Bernheim, 1994); people simply plan to adopt behaviour that conforms to the perceived shared norm of their peers, without any additional deep-minded deliberations.

Our data also reveal some puzzling findings. Why are experimentally elicited preferences poor predictors of future lockdown compliance behaviour, while stated preferences are good predictors? A possible reason is the methodological rupture between the real and the hypothetical questions. Incentivized tasks are designed to reveal real preferences, in contrast to stated preferences questions where respondents are asked about how they believe they are. Statements about future compliance share the same hypothetical dimension. Despite these methodological considerations, we were surprised that, as predictors of self-reported level of lockdown compliance, we obtained a relative advantage of the self-reported tools toward elicited measures of social, risk and time preferences. Our findings contribute therefore to the existing literature investigating the concordance between stated and revealed preferences and the external validity of those measures to predict actual field behaviours. Indeed, the generalizability of lab experiments is questionable (Levitt and List, 2007) as well as their ability to predict real life behaviours[9].

Our study is not the first to test a nudge for lockdown compliance. However, we think it is the first to discern the psycho-economic traits that are most strongly correlated with the likelihood of positive outcome for the nudge policy, among a representative sample of the people. However, this study also

[9] The correlation between survey measures and incentivized measures of risk preferences was first established by Dohmen et al. (2011) for the German national panel. These findings were replicated by Vieider et al. (2015) for a large sample of nearly 3000 respondents spread over 30 countries, and in a lesser extent by Frey et al. (2017) who found only a weak correlation. Concerning the external validity of the measures, Anderson and Mellor (2008) found evidence that elicited risk measures corelates with risky behaviours in the field (such as smoking, drinking and obesity) for a large non-representative sample of the US population. In contrast, Galizzi et al. (2016) and Charness et al. (2020) found mixed and no evidence for UK and Dutch representative samples. Concerning social preferences, the systematic review conducted by Galizzi and Navarro-Martinez (2019) highlighted mixed evidence for the correspondence between the behaviours in social dilemma, charitable behaviours observed in the field, and GSS survey questions. The literature on time preference is scarcer. Harrison et al. (2018) review the literature between elicited measure of risk and time preferences and smoking behaviour and found no difference in risk preferences between smokers and non-smokers, but found that smoking correlates with the discounting intensity and hyperbolic discounting. Overall, it is fair to say that the evidence about the predictive power of preferences elicited in the lab for outside-lab behaviour is mixed.

has several limitations. First, we need to be cautious about norm sharing (here, peers' compliance) and actual compliance. Gächter et al. (2017) showed that norm sharing is strongly affected by the observation of peers' actions, but that this does not necessarily affect their behaviour[10]. Indeed, we did not observe the actual lockdown compliance but a declared self-reported measure, in case of rebound. In particular, responses may be influenced by social desirability concerns, and this could likely bias some of our findings. Nevertheless, at a minimum, our results show that the social-influence nudge is acting on compliance intentions. This point is reinforced by the RCT design of our study, thanks to which the gaps between groups 1 and 2 should not be explained by omitted variables, but by the nudge-treatment itself. We also recognize that the limited size sample we have to observe and study the positive effect of the nudge is also a weakness.

[10] Gächter et al. (2017) consider a three-player sequential dictator game, with two dictators and a single recipient. In their PEER treatment, the second dictator observes the first dictator's transfer. The authors observe a strong effect on the (incentivized) measurement of the social appropriateness judgement about the second dictator's transfer. Despite this effect on the appropriate norm of conduct, it does not affect the effective transfers of the second dictator compared to the NO-PEER treatment.

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Appendix

Figure A1 compares several statistics (gender, age, regions) of our sample to those of the National Institute of Statistics and Economic Studies (INSEE).

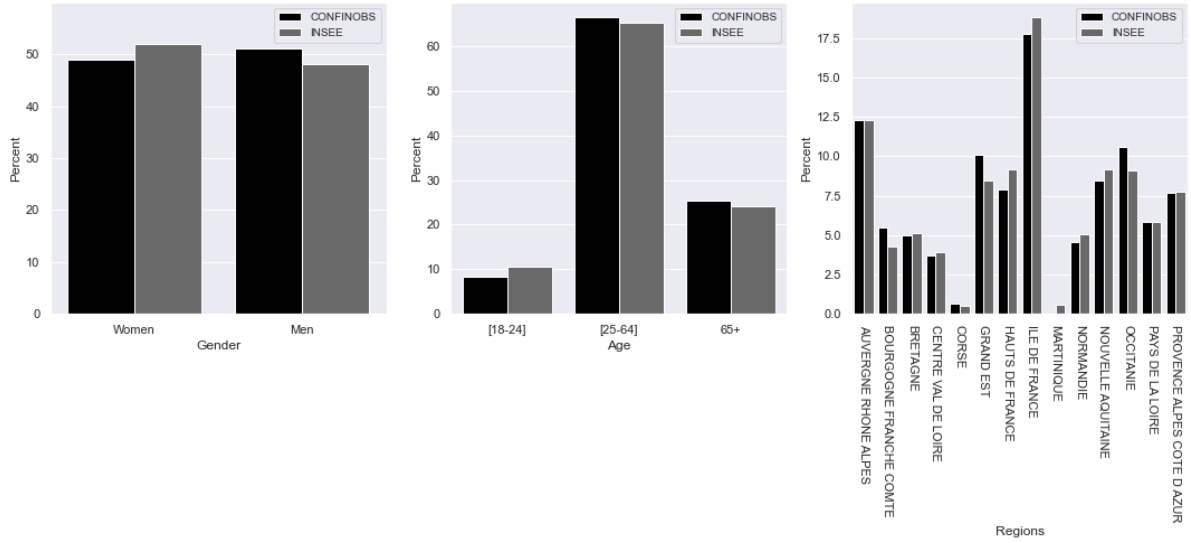

Figure A1. The left graph reports gender frequencies, the middle graph age frequencies and the right graph regional frequencies. The black colour represents the CONFINOBS sample and the grey colour the sample of the french National Institute for Statistical and Economic Studies (INSEE, January 2020).

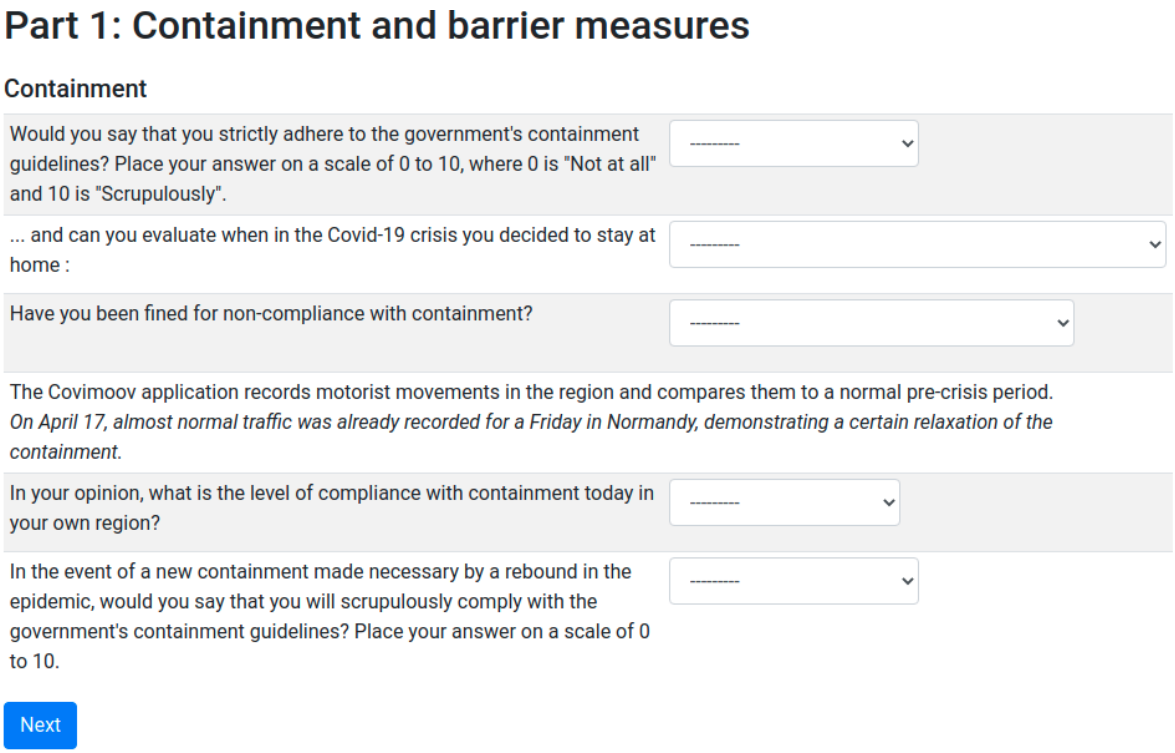

Figure A2: Screenshot of the questionnaire (Negative nudge here)

	CRR							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Nudge								
Nudge	−0.039	−0.071	−0.037	−0.061	−0.064	−0.057	−0.079	−0.061
	(0.201)	(0.205)	(0.202)	(0.205)	(0.189)	(0.193)	(0.188)	(0.194)
Nudge×Normandy	1.546*	1.558*	1.520*	1.490*	1.821**	1.837**	1.799**	1.761**
	(0.919)	(0.890)	(0.920)	(0.890)	(0.862)	(0.843)	(0.861)	(0.843)
Nudge×Neighbouring	−0.590	−0.339	−0.561	−0.336	−0.618	−0.493	−0.613	−0.523
	(0.653)	(0.649)	(0.652)	(0.649)	(0.609)	(0.610)	(0.607)	(0.609)
Elicited preferences								
Risk_aversion			−0.187	−0.256*			−0.104	−0.169
			(0.137)	(0.137)			(0.129)	(0.131)
SVO_angle			0.092	0.046			0.115	0.045
			(0.094)	(0.096)			(0.089)	(0.091)
PGG			0.210	0.253*			0.257**	0.302**
			(0.138)	(0.138)			(0.130)	(0.131)
Discount			−0.006	0.012			−0.044	−0.020
			(0.095)	(0.096)			(0.089)	(0.092)
Present_bias			0.075	0.004			0.085	0.021
			(0.096)	(0.096)			(0.090)	(0.091)
Stated preferences								
Risk_general					−0.502***	−0.474***	−0.516***	−0.487***
					(0.115)	(0.120)	(0.115)	(0.121)
Risk_financial					−0.071	−0.034	−0.094	−0.051
					(0.101)	(0.105)	(0.102)	(0.106)
Risk_health					−0.465***	−0.406***	−0.452***	−0.398***
					(0.106)	(0.110)	(0.106)	(0.110)
Trust_general					−0.233**	−0.225*	−0.244**	−0.227*
					(0.117)	(0.121)	(0.117)	(0.121)
Trust_family					0.363***	0.356***	0.357***	0.358***
					(0.110)	(0.110)	(0.110)	(0.111)
Trust_professional					−0.219*	−0.211*	−0.228*	−0.223*
					(0.119)	(0.121)	(0.119)	(0.122)
Patience					0.104	0.142	0.095	0.135
					(0.092)	(0.094)	(0.092)	(0.094)
Mindfulness					0.291***	0.321***	0.291***	0.323***
					(0.093)	(0.096)	(0.093)	(0.096)
Control	No	Yes	No	Yes	No	Yes	No	Yes
Constant	9.774***	9.259***	9.765***	9.243***	9.779***	9.132***	9.779***	9.114***
	(0.145)	(0.284)	(0.145)	(0.283)	(0.136)	(0.268)	(0.136)	(0.268)
Normandy	−0.492	−0.674	−0.447	−0.632	−0.490	−0.527	−0.419	−0.462
	(0.652)	(0.632)	(0.652)	(0.631)	(0.608)	(0.596)	(0.608)	(0.596)
Neighbouring	0.368	0.257	0.403	0.294	0.380	0.255	0.428	0.305
	(0.485)	(0.484)	(0.485)	(0.484)	(0.452)	(0.455)	(0.451)	(0.455)
Observations	1,154	1,047	1,154	1,047	1,154	1,047	1,154	1,047
Log Likelihood	−1,908.724	−1,711.783	−1,906.735	−1,709.626	−1,832.249	−1,650.824	−1,828.600	−1,647.851
Wald Test	4.278	61.663***	8.271	65.929***	153.921***	178.407***	160.716***	183.457***
Note:								*p<0.1; **p<0.05; ***p<0.01

Table A1: results of Tobit regression.

Note: Results in terms of model comparison are similar than with the probit method. Models 3, 4, 7 and 8 are not statistically better than models 1 [LR-test, p=0.552], 2 [LR-test, p= 0.505], 5 [LR-test, p=0.199] and 6 [LR-test, p=0.312].